

TECHNOLOGY DEPT.

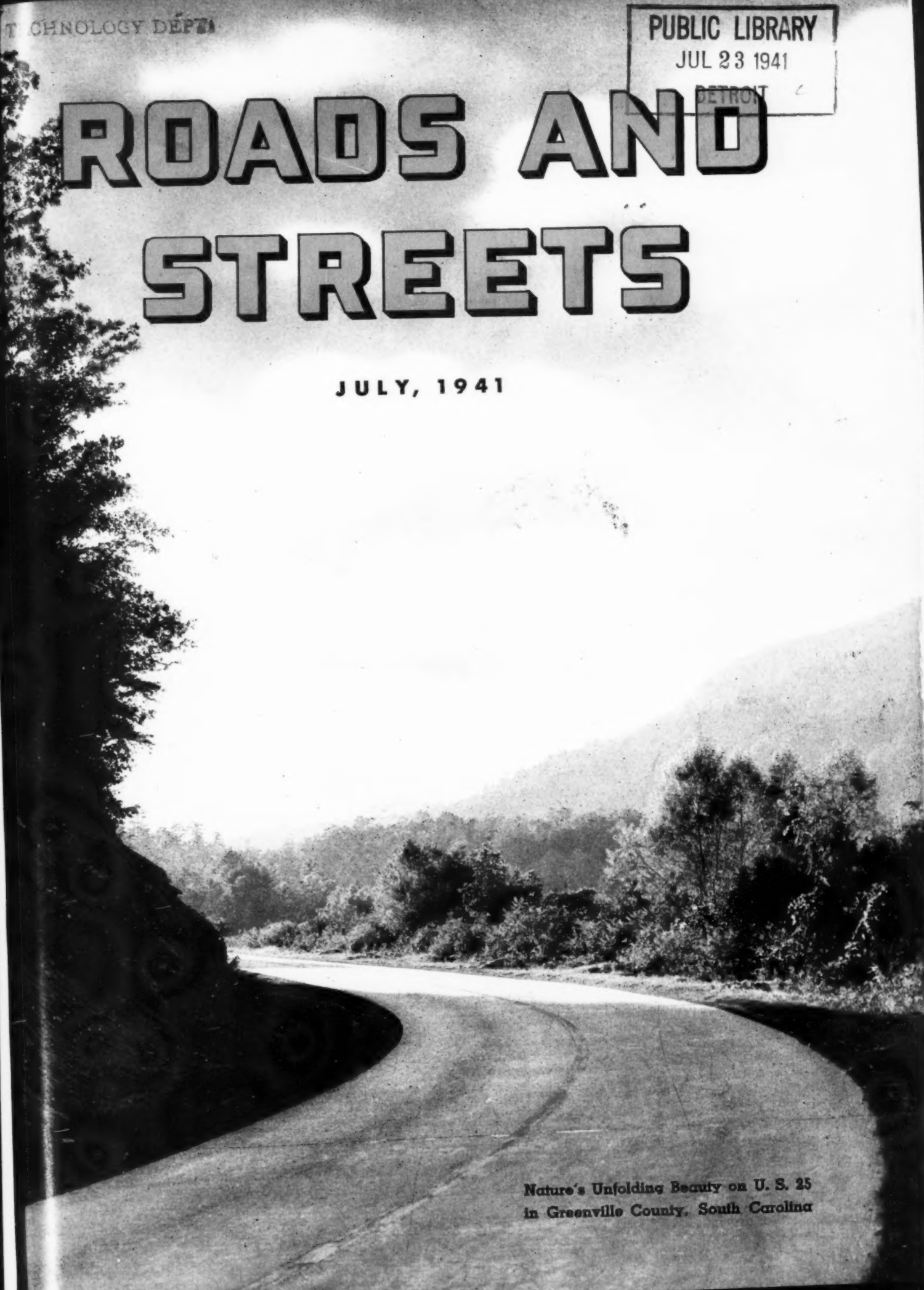
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DETROIT

ROADS AND STREETS

JULY, 1941



Nature's Unfolding Beauty on U. S. 25
in Greenville County, South Carolina

FULL OF FEATURES
you'll like



**THE ADAMS LINE
ALSO INCLUDES:**

LEANING WHEEL GRADERS
6½ to 12 ft. blade sizes.
Hand and power operated.

ELEVATING GRADERS
With 42 or 48 in. carriers.
Fully power operated.

HAULING SCRAPERS
Cable-controlled.
Available in several sizes.

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With exclusive removable
foot feature.

ROAD MAINTAINERS
Multiple-blade type with auto-
matic blade control feature. For
high-speed operation (up to 15
m.p.h.) behind trucks or tractors.

**ROTARY SCRAPERS,
PLOWS, ETC.**

Blades for All Types and Makes
of Road Machines.

● **W**HEN YOU determine to buy a motor grader don't make the mistake of concluding that all makes are about alike. There are certain mechanical and operating features which you should demand. You get all of them in Adams Motor Graders as listed below:

BALANCED WEIGHT DISTRIBUTION

Proper weight on rear wheels for traction; on front end to prevent skidding away from heavy side loads; and on scarifier and blade to cut through hard material.

RIGID BLADE SUPPORT FOR SMOOTH CUTTING

Strong, rigid frame—rigidity and absence of lost motion in blade control. Important on maintenance and fine grading.

WIDE RANGE OF TRAVEL SPEEDS

Provides proper speed for doing every job in least time and at lowest cost. High top speeds for transporting.

POSITIVE MECHANICAL CONTROLS

Faster and more accurate blade adjustments than with hydraulic controls. Cause less trouble—easier to service.

HIGH BLADE LIFT FOR BANK WORK

Adams Motor Graders are adjustable to handle all types of surface, ditch and bank work.

EASY STARTING ENGINES

Diesel engines that start instantly on gasoline and switch to full Diesel operation without the use of auxiliary engines, extra batteries, etc.

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Conveniently located controls. Operator's seat adjustable horizontally and vertically. Operator always has good vision of work whether seated or standing.

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Three models with gasoline engines and three models with Diesel engines permit selecting machine to best suit your purse and purpose.

See your local Adams representative today for further particulars, or write for descriptive catalogs.

J. D. ADAMS COMPANY • INDIANAPOLIS, INDIANA

ADAMS *Motor Graders*

A PUDDLE OF WATER TELLS THE STORY...

*of greater driving visibility with
White Concrete Reflecting Curb!*

(The wet spot appears black)

WET

DRY

BLACK AS NIGHT is smooth-finished concrete curb when wet. Why? When dry, smooth curb reflects most headlight rays forward, away from the driver. When wet, it reflects practically all light forward; hence, this curb even though of white concrete, appears black. Imagine the complete blackout of smooth curb all along the highway on a rainy night!

WET

DRY

BRIGHT AS DAY is new White Concrete Reflecting Curb when wet. Why? When dry, saw-tooth faces of Reflecting Curb reflect most headlight rays back to the driver. When wet, even more light is reflected back to the driver; hence, this curb provides an even brighter guide to safety on rainy nights than on dry nights. Which type of curb would you trust with your life?

► Get the full story about this new curb made with Atlas White Cement. Write to Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), Chrysler Building, New York City.

WS-M-22

WHITE CONCRETE REFLECTING CURB

MADE WITH ATLAS WHITE CEMENT



ROADS and STREETS

With which have been merged GOOD ROADS and ENGINEERING & CONTRACTING

ESTABLISHED 1892

Published Monthly by GILLETTE PUBLISHING COMPANY, 330 South Wells Street, Chicago, Illinois

CCA

This Magazine Is Devoted to

Design, Construction, Maintenance and Operation of Highways, Streets, Bridges
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WATER WORKS & SEWERAGE
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No. 7

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**BUY for the TOUGH
DIGGING and you
won't have to worry
about output in DIRT!**

GASOLINE
ELECTRIC
DIESEL
OIL

Built
in a range
of 18 SIZES.
3/4 yd. capacity
and
Larger

NORTHWEST

**SHOVELS
DRAGLINES**

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•

**CRANES
PULLSHOVELS**

EASY digging never worried any contractor. Any shovel will handle dirt! But even the man who begins on dirt today may find he's got a rock contract tomorrow. Then that Northwest Welded Boom (and no Northwest Welded Boom has ever failed), those welded dipper sticks tied together with a cap casting that work as a unit, the Northwest Dual Independent Crowd that utilizes force other shovels waste, the Cushion Clutch, the "feather-touch" Clutch Control — all the advantages that have made Northwest so outstanding as a Rock Shovel become money makers. Buy for the tough digging and the easy digging will take care of itself.

**NORTHWEST
ENGINEERING CO.**
1732 Steger Building
28 East Jackson Blvd.
Chicago, Ill.

You'll find it in a
FORD TRUCK
and nowhere else!



TO FORD TRUCK engineers, the word "exclusive" means "better" as well as "different." The lowest-priced Ford Truck has a number of *exclusive* quality features that help you haul better—faster—cheaper!

See the Ford Dealer about the *exclusive* and *time-tested* features which are available in Ford Trucks, but found in no others! Ask him to arrange an "on-your-job" test. With choice of 42 body and chassis types, 6 wheelbases and 3 engine sizes, there's a Ford combination for your loads!

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- ✓ Only the Ford has **DIRECT DRIVEN DISTRIBUTOR** for super-accurate timing.
- ✓ Only the Ford has **CAST STEEL CRANKSHAFT AND CAM-SHAFT** for exceptional resistance to wear. 300% longer wearing.
- ✓ Only the Ford has **PRECISION-SET VALVES**—with intake and exhaust valve seat inserts—for longer-life efficiency. No lifters to adjust.
- ✓ Only the Ford has **STARTER BUTTON ON INSTRUMENT PANEL**—leaving both feet free to operate pedals when starting on hills.

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 AND COMMERCIAL CARS





DEFENSE PRESSURE

on industrial equipment makes *correct* lubrication all the more important. For **CONSTRUCTION MACHINERY** there are...

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developed to meet peak load and overload operation. For longer service periods between overhauls and lower lubrication costs try Sinclair specialized lubricants. Get details from nearest Sinclair office, or Sinclair Refining Co., 630 Fifth Ave., New York, N. Y.

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.



BUDA Diesel-powered Bucyrus Erie shovel operated by Frank Mashuda Co., at Mt. Pleasant, Pa., with Sinclair oil and fuel.

SINCLAIR LUBRICANTS-FUELS

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2540 WEST CERMAK ROAD
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NEW YORK CITY

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KANSAS CITY

573 WEST PEACHTREE STREET
ATLANTA

FAIR BUILDING
FT. WORTH



UPPER LEFT: Trees, ravines, steep grades—and an International TD-6 Diesel Tractor with bulldozer. The job: storm sewer construction; 7,500 yards of dirt to be excavated.

ABOVE: Carving a new road through California woods with a TD-14 Diesel and cable-operated bulldozer. "Easy to operate, lots of power," says operator. Output of this tractor and bulldozer combination is 1,000 yds. per 10-hour day. Fuel used: 2 gallons an hour.

LEFT: Stripping down a high bank. The big International TD-18 is furnishing economical, sure-footed power. The scraper has 10 cubic yard (heaped) capacity.

INTERNATIONAL

TRACTOR SERVICE *"Bases"* COAST TO COAST



The full line of International Industrial Power, sold at 102 International Harvester branches in United States and Canada and by dealers from coast to coast, includes:

TracTracTors (crawlers)—7 models: 4 Diesels (TD-6, TD-9, TD-14, TD-18) and 3 carburetor-type (T-6, T-9, T-14).

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Modified Units—Available to manufacturers to power a wide variety of allied equipment.

**Like the NAVY, ARMY, and AIR FORCE,
TRACTORS Need BASES, TOO!**

TRACTORS NEED "BASES," whether they are working for Uncle Sam or for you.

Convenient "bases," with up-to-the-minute service facilities, have long been part of an established after-sale service policy with International Harvester. The complete line of International Industrial Power (TracTracTors, Wheel Tractors, Power Units) is backed by a vast network of Company-owned branches in the United States and Canada. These branches, in

connection with scores of authorized industrial dealers, provide fast, thorough service to owners and operators of International Industrial Power in all parts of the country.

These service "bases" are a good thing to remember when you are planning a power investment. Ask the nearest International Industrial Power dealer or Company-owned branch about the International Industrial Power line. Write for information—no obligation.

INTERNATIONAL HARVESTER COMPANY
180 North Michigan Avenue Chicago, Illinois

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Tor with
struction;

Califor-
le-oper-
lots of
tractor
ds. per
our.

The big
omical,
0 cubic

Industrial Power

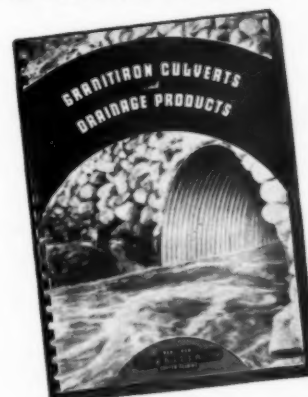
Unceasing Planning...



*... to give you more culvert life
per dollar invested*

Years of experience in making quality steel sheets is supplemented in the Granite City Steel plant by ceaseless research and planning. These are directed toward still greater improvements in culvert quality and service. That's an outstanding reason for the enviable reputation enjoyed by Granitiron Corrugated Metal Culverts among highway engineers, contractors and officials.

Before your next purchase, get all the facts on Granitiron Culverts . . . their unusual resistance to rust and corrosion, result of careful selection of raw materials and laboratory control at every production stage . . . their exceptional low cost per year of service.



64 PAGES OF FACTS
To Help You Solve Drainage Problems Efficiently,
Economically. Send for
Your **FREE** Copy Today.

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STEEL COMPANY

DIVISION
ILLINOIS

... For Dependable ...

GRANITIRON

PURE IRON
COPPER BEARING

... Lifetime Service ...

Power shovel service at your door with *Timken "6-wheelers"* (Tandem Drive)

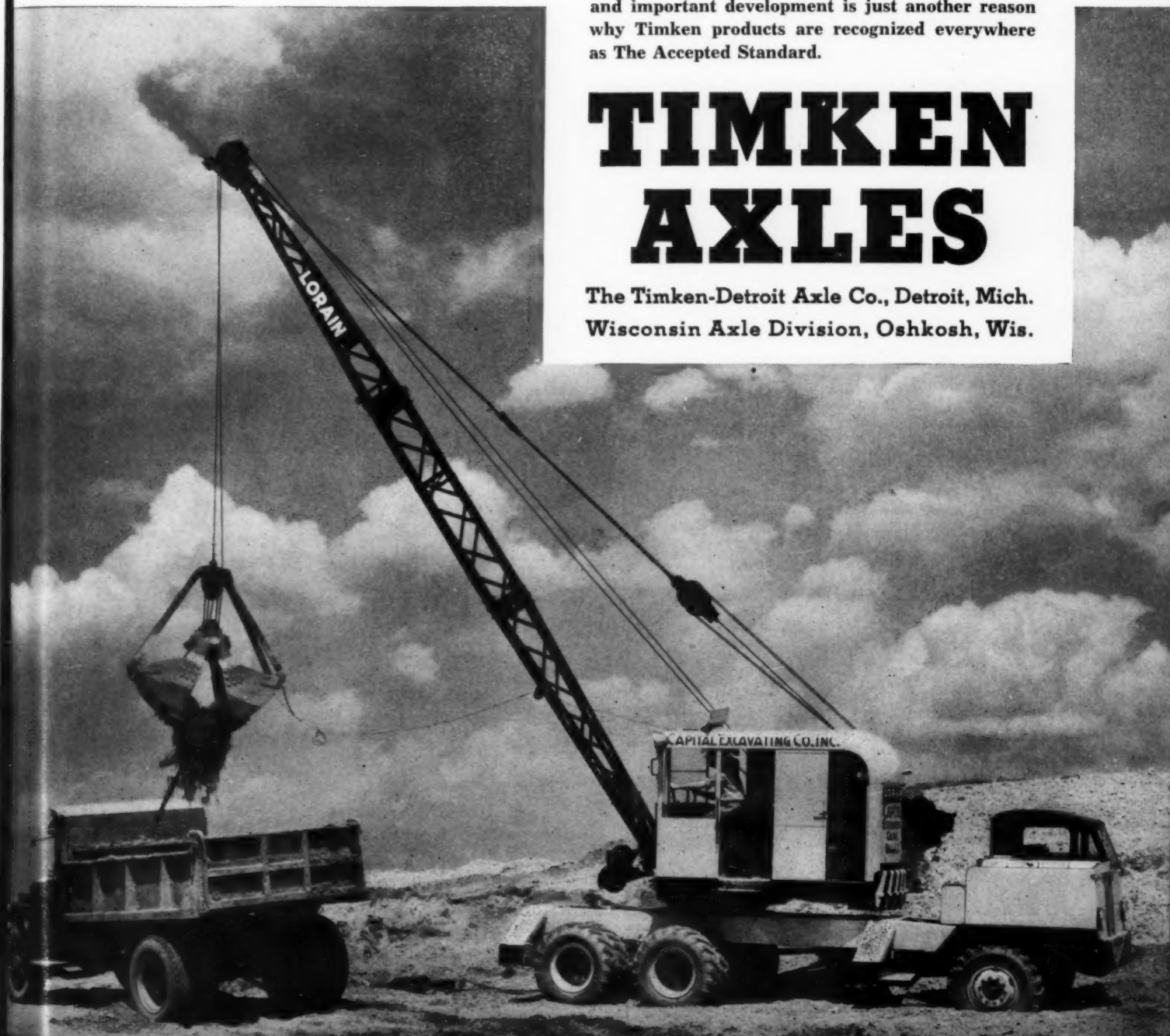
Hats off to Thew, makers of Lorain power shovels, and to other farsighted, progressive power shovel manufacturers! They've put real "get-up-and-go" into their products.

No longer is it necessary to figure days between jobs and unnecessary delays in getting around on the job. Sturdy shovels (cranes, too) mounted on special extra heavy chassis with Timken 6-Wheel Tandem Drive Axle Units speed over the highways—save time getting to and from each job—do each job better and faster, and literally bring power shovel service to your door at new low costs and with greater dependability.

That Timken Axles are a vital part of this new and important development is just another reason why Timken products are recognized everywhere as The Accepted Standard.

TIMKEN AXLES

The Timken-Detroit Axle Co., Detroit, Mich.
Wisconsin Axle Division, Oshkosh, Wis.



MAKES SATISFACTORY LOW-COST ROAD

PROVIDES SMOOTH RIDING SURFACE

IS ONE STEP FORWARD IN STAGE CONSTRUCTION

IT IS STABLE AND DURABLE

HAS NON-SKID SURFACE

ADAPTS ITSELF TO BASE MOVEMENTS

PROVIDES LOW COST VEHICLE OPERATION

HAS PROVEN ITSELF TO HIGHWAY OFFICIALS

REDUCES MAINTENANCE COSTS

UTILIZES LOCAL MATERIALS

STRENGTHENS OLD GRAVEL ROADS

IS SAFER THAN GRAVEL ROADS

IMPROVES LIQUID ASPHALT BINDERS

IS NOT AN EXPERIMENT

UTILIZES LOCAL LABOR

IMPROVES OIL MAT CONSTRUCTION

16
BIG POINTS
IN FAVOR
of
LINCOLN-ITE
PULVERIZED PETROLEUM ASPHALT
TRADE MARK REGISTERED IN UNITED STATES AND CANADA

THE OHIO OIL COMPANY
INCORPORATED

ASPHALT
DIVISION
ROBINSON
ILLINOIS

THE AIRPORT PAVER OF TODAY

thruout the U. S. and Canada



On Canada's Camp Borden Training Centre Runways



Paving San Pedro, California, Airport

17 Ft. Straight Edge
"Equalizers" Insure
Smoother Surface . . .
(Can Lay Material Flush
to Curb, Header or Form!)

Only Paver Adjustable
for Widths up to 15 Ft.
--- Can Lay Up to 30 Ft.
in 2 Lanes Instead of 3
... and with Up to 25%
Bigger Daily Tonnage!

From the days when Jaeger Bituminous Pavers, equipped with lights and heated screeds, worked late hours to complete the British Government's Botwood Airport in Newfoundland, where runways equal 190 miles of 20 ft. road, Jaeger has been the overwhelming favorite of Dominion engineers and contractors. In the U. S., from Portland, Maine to San Pedro and other California fields, the Jaeger Paver has proved its outstanding advantages for air field construction: TELESCOPIC ADJUSTABILITY FROM 9 TO 15 FT. — WIDER.

THEREFORE FEWER, LANES — INCREASED TONNAGE — SMOOTHNESS OF SURFACE EQUIVALENT TO FORM WORK — ABILITY TO LAY FLUSH TO CURB, CONCRETE HEADER OR RETENTION FORM — HEATED SCREEDS THAT PERMIT YOU TO START EARLIER, MOVE FASTER, WORK LATER.

Send for Catalog describing these and other important features for high production paving of airports, highways, city streets. THE JAEGER MACHINE CO., 223 Dublin Ave., Columbus, Ohio.

WORLD'S LARGEST MANUFACTURER of BITUMINOUS and CONCRETE SPREADING and FINISHING EQUIPMENT—Bituminous Pavers, Spreaders, Widening Spreaders - Concrete Finishers for Slab and Widening, Screw Spreaders - Auto-Pavers - Concrete, Plaster, Mortar Mixers - Pumps - Hoists - Towers

JAEGER ADJUSTABLE STREET, HIGHWAY AND AIRPORT PAVER



WHEN YOU EXAMINE YOUR UNPAVED ROADS—



Loose and untreated



Consolidated and calcium chloride treated

There's More to Be Found Than Meets the Eye!

It takes only a glance at the two roads pictured to know which one means safe, comfortable motoring by satisfied taxpayers and which road means the exact opposite. From this standpoint alone is public

judgment decided. To the highway official, however—who goes deeper into the reasons for consolidating loose surface materials—these definite *economic* benefits are revealed:



MATERIAL SAVINGS

Calcium chloride consolidated materials are held in the road to give 100% service, eliminating dust and replacement expense.



FROST RESISTANCE

Calcium chloride consolidated materials are highly resistant to frost action, so springtime repairs are substantially reduced.



LESS MAINTENANCE

Calcium chloride consolidated materials resist ravelling, corrugating or pot-holing, so maintenance blading is cut to a minimum.



BETTER BASES

Calcium chloride consolidated materials attain a density nearly that of concrete, so constitute ideal bases for future surfacing.

The method is not new or theoretical—experiences on thousands of miles of consolidated roads confirm the facts. It is not difficult—local materials and simple equipment are used. And it is within the

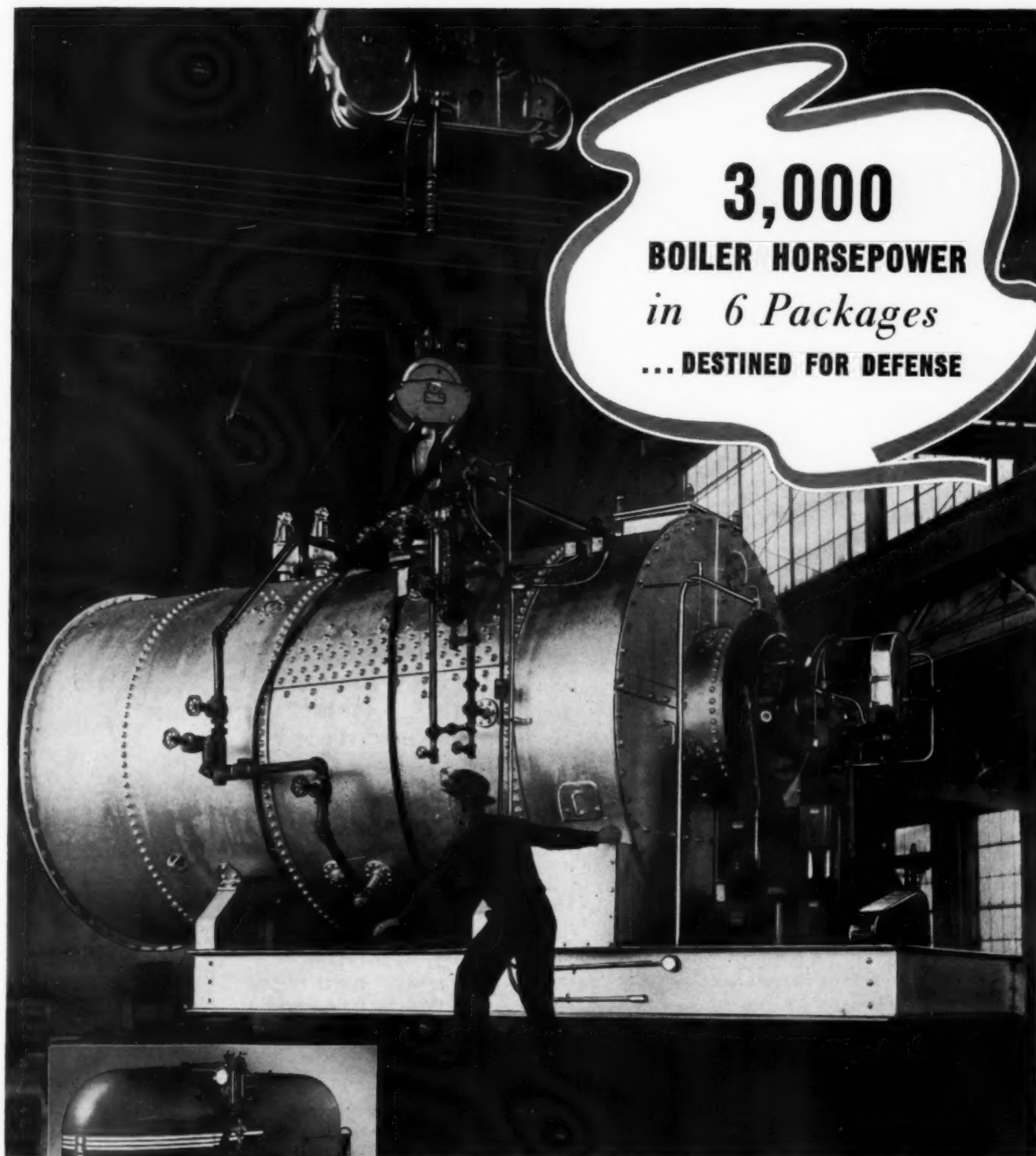
immediate means of any road budget.

Full information and engineering service are yours without obligation. Ask for it now. There is still time to have better roads at no added cost *this* year.

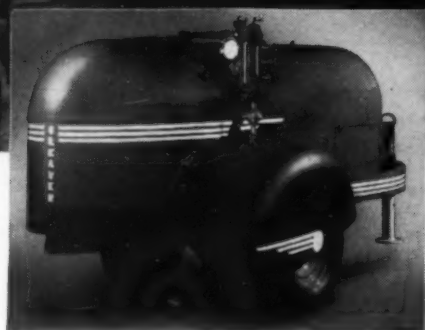
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CALCIUM CHLORIDE

F O R R O A D I M P R O V E M E N T



3,000
BOILER HORSEPOWER
in 6 Packages
... DESTINED FOR DEFENSE



Whatever equipment you need to heat, circulate and pump all grades and kinds of bituminous materials in tank cars or storage, there is a Cleaver Tank Car Heater or Pumping Booster to do the job faster—with substantial savings of fuel, water, time and money. Write for bulletin and complete information.

The Oilbilt Steam Generating Plant, shown being loaded on a flatcar, is one of six 500 HP. units destined for service at an eastern naval base.

Roads and Streets readers are familiar with the superior performance of Cleaver Tank Car Heaters. Oilbilt owes its outstanding performance and nation-wide acceptance to the Cleaver Tank Car Heater. Its four-pass, down draft and integral burner construction is lifted directly from the Cleaver design, providing steam at lowest cost plus unusual advantages of compact, simple installation.

We believe this recognition of equipment built by Cleaver-Brooks Company to be of important significance to those who build and maintain bituminous roads.

CLEAVER-BROOKS COMPANY, MILWAUKEE, WIS.

***Cleaver* TANK CAR HEATERS AND BOOSTERS FOR BITUMINOUS MATERIALS**



WHEN OWENS *perform* SAND *is moved* PROFITABLY

Speed and More Speed is the cry on construction jobs and industrial projects.

Setting the pace in bucket designing, Owen Engineers have still further improved Owen buckets in performance features and endurance ability.

For big grabs and a "mouthful at every bite" specify an "Owen Bucket."

The OWEN BUCKET Co.
6070 BREAKWATER AVE., CLEVELAND, OHIO

BRANCHES: New York, Philadelphia,
Chicago, Berkeley, Cal.



Pioneer "ONE SHOT" Lubrication On Belt Conveyor Idlers . . .

- saves you money and labor because one fitting greases all the bearings.
- reduces your investment because only one walkway is necessary.
- lowers your replacements and maintenance costs because they don't miss any bearings.

Write for details on Pioneer Belt Conveyors
and Conveying Equipment

PIONEER ENGINEERING WORKS
MINNEAPOLIS, MINNESOTA

Entrance to all Points of Interest
New York's Popular
HOTEL LINCOLN
44TH TO 45TH STS. AT 8TH AVE.

OUR CHOICEST ROOMS From **\$3**
1400 ROOMS each with
Bath, Servidor, and Radio.
★ Four fine restaurants
awarded Grand Prix 1940
Culinary Art Exhibition.

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HOTEL EDISON
SAME OWNERSHIP



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HEAVY DUTY TRAILER CATALOG *You've Needed!*

IT'S OVERFLOWING WITH

HELPFUL INFORMATION
AND FACTS.

**ROGERS BROS.
CORPORATION**

110 ORCHARD STREET ALBION, PA.

EXPERIENCE *builds 'em* **PERFORMANCE** *sells 'em*

WRITE for your copy
TODAY!

5 MEN INSTALL THIS 90-INCH CULVERT

-in 4 days!

WITH U·S·S SECTIONAL PLATES



REPLACING A SMALL BRIDGE with a 90-inch culvert built from U·S·S 7-gage Sectional Plate. Installed by Young and Greenawalt.



THIS 90-inch corrugated metal culvert replaced a failing bridge under the main line of a western railroad. The entire job — excavation, plate erection, backfilling, removal of old caps, stringers, and handrail, and placing the rip-rap headwalls—was finished in four days without stopping traffic.

This shows how U·S·S Sectional

Plate construction saves time and money. A few men—and they don't need to be highly skilled—can install a culvert as strong as a small bridge. The installation was inspected carefully a year and a half after erection and found to be in perfect condition.

What's more, the cover over the pipe is small so that the top of the

culvert takes a severe pounding every time a train goes over it. If highway or railway engineers have any doubts as to the strength and resistance to impact of large corrugated culverts, this, and other installations like it, should dispel any fears.

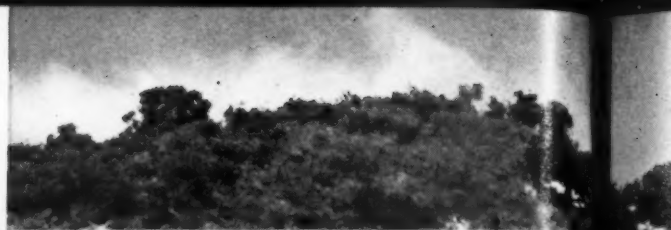
We'll gladly give you all the details of this job or answer questions about your own problems. Just write.

CARNEGIE-ILLINOIS STEEL CORPORATION, Pittsburgh and Chicago
COLUMBIA STEEL COMPANY, San Francisco
TENNESSEE COAL, IRON & RAILROAD COMPANY, Birmingham
Scully Steel Products Company, Chicago, Warehouse Distributors
United States Steel Export Company, New York



UNITED STATES STEEL

• Here's a "Caterpillar" Diesel D8 Tractor bulldozing rock and earth on a cut through the rugged California hills. The highway once made a long circuit at this point. Now it runs straight through!



ROAD COMING THROUGH!

Roads used to follow the line of least resistance. They went around hills, twisted through winding valleys or climbed painfully up and down rocky grades — because they couldn't do anything else.

Today you can build your road where you want it. Hills are cut through and rocks shoved aside when "Caterpillar" Diesel Tractors tear into the job!

Watch a "Caterpillar" Diesel D8 roughing out a road. With 17 tons of heavy-hitting power behind the 'dozer, a lot of dirt gets out of the way in a hurry. But it's not only the horsepower of these husky machines that makes them the world's greatest earth movers. It's their scientifically balanced weight and long, broad tracks with deep-biting grouzers — giving them tremendous traction in any kind of footing.

On road-building and defense jobs today, *time* is the vital factor. You need equipment that will stay on the job—keep going night and day—and put it through on schedule. With "Caterpillar" Diesel Tractors, Engines and Road Machinery, you get fuel economy and tough dependability that bring the cost figures down. But beyond that, you get load-moving power and traction that keep production up!

CATERPILLAR TRACTOR CO., PEORIA, ILLINOIS



CATERPILLAR

REG. U.S. PAT. OFF.

ENGINES AND ELECTRIC SETS • ROAD MACHINERY



D I E S E L

TRACK-TYPE TRACTORS

**ESSENTIAL TO
NATIONAL DEFENSE**

is fast, dependable earth-moving power
— for the construction of roads, air-
ports, cantonments, naval bases and
munitions plants. Defense fronts all!

**WITH A
3/4 SWING
BADGER
ON THE JOB**



There's NO FOOLIN' AROUND

● Every feature of conventional shovel design that is an obstacle to speed and output has been eliminated in building the A-W BADGER.

Size of dipper . . . digging speed . . . speed in swinging . . . low center of gravity that makes it possible to use 15 tons of upward pull for ripping through any material . . . ALL contribute to the BADGER'S amazing output.

An investigation will demonstrate conclusively that no full-swing shovel can approach the BADGER on these output-increasing points. Yet the BADGER 1/2-yard Shovel is priced lower than many 3/8-yard shovels. See it perform as a shovel, dragline, trench hoe, pile driver or skimmer before you buy. THE AUSTIN-WESTERN ROAD MACHINERY CO., Aurora, Illinois.

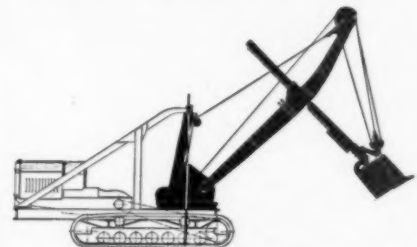
Austin-Western

MOTOR GRADERS
LOADERS
BLADE GRADERS
ELEVATING GRADERS

HYDRAULIC SCRAPERS
CRUSHING AND
SCREENING PLANTS
CABLE SCRAPERS
ROLLERS

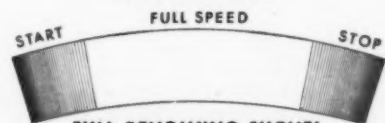
ROLL-A-PLANES
MOTOR SWEEPERS
BITUMINOUS
DISTRIBUTORS
SHOVELS AND CRANES

The BADGER'S level full measure is exactly 12 cubic feet. From top of teeth to back of dipper it measures 13-1/2 cubic feet. Heap measure gives a capacity in excess of a full half yard.



The single line maximum pull of the BADGER is 10,000 pounds. Thus the three part line used results in a 30,000 pound pull . . . tremendous digging power.

BADGER SHOVEL



FULL REVOLVING SHOVEL

Diagrams above show greater period of FULL SPEED provided by the BADGER'S faster start and stop. This extra period of full speed is possible because the BADGER has no excess load to be brought to full speed, stopped and reversed within the limits of a short swing.

... FROM CANADA TO ARGENTINA

FAST PRODUCTION OF MILLIONS OF YARDS OF CONCRETE PAVING PROVE THE VALUE OF

BLAW-KNOX CONCRETE SPREADERS

The value of the BLAW-KNOX CONCRETE SPREADER is the ability of its transverse spreading blade to easily and effectively handle the top output of any paver . . . to spread concrete without segregation . . . to spread concrete as dry as $\frac{1}{2}$ inch slump . . . to spread and move concrete ahead without disturbing road form alignment.

Dump concrete anywhere on the subgrade and the spreader does the rest. It's a completely mechanical operation — the spreading blade action is automatic.

Narrow machines can be converted to wide ma-

chines, and vice versa. Vibratory attachment for the Blaw-Knox Concrete Spreader can be furnished if required.

Many tales of paving production reaching us sound almost fantastic, but they're true, and the contractors aren't a bit hesitant in telling about the job-getting and money-making ability of the Blaw-Knox Concrete Spreader.

If you plan to bid on road and airport paving, your figures can be revised downward if you use a Blaw-Knox Concrete Spreader.

BLAW-KNOX DIVISION of Blaw-Knox Co.
 2003 Farmers Bank Building Pittsburgh, Pa.
 New York Chicago Pittsburgh Birmingham
Representatives in Principal Cities

The Blaw-Knox Transverse Blade CONCRETE SPREADER automatically spreads the concrete dumped by the paver. It spreads for laying mesh, and then spreads the top course to finished grade. Vibrator attachment available.

BLAW-KNOX CONSTRUCTION EQUIPMENT

Includes:

- Bins & Batchers
- Road Forms
- Street Forms
- Concrete Spreaders
- Tamping Rollers
- Vibrators
- Concrete Buckets
- Clamshell Buckets
- Truck Mixers
- Striping Machines
- Turntables
- Road Finishers
- Steel Forms



"War is Hell"

...ON BRIDGES!



★ America needs good bridges. From motorized columns to monster tanks the army must be able to move swiftly and efficiently. No bottlenecks. No detours. A huge task, admittedly, but here is something that will make it easier...

Use durable ARMCO Multi Plate to replace weak structures or widen narrow ones. Multi Plate is an especially wise choice when speed is demanded. The rugged plate sections come to the job site ready for quick, easy assembly. No special equipment or skilled labor is needed. An average installation is completed in a few days and you have a bridge that meets every requirement for strength and durability.

Building strong, low-cost Multi Plate bridges brings benefits in peacetime as well as wartime. Low maintenance and trouble-free service are assured. You will also find ARMCO Multi Plate Pipe and Arches ideal for building stream enclosures, large sewers or special drainage structures. Write us for complete data. ARMCO DRAINAGE PRODUCTS ASSN., 5073 Curtis St., Middletown, O.



1 Banish "fifth column" bridges! The simple, effective way is to replace or extend them with ARMCO Multi Plate.

2 Strength to spare! In actual tests a Multi Plate Arch 10 feet long and with a 20-foot span withstood loads up to 350 tons.

3 Full speed ahead! A few days and you have a bridge that will last as long as the road. Finish off with any headwall you like.

ARMCO



MULTI PLATE PIPE OR ARCHES

A TYPE OF PRODUCT ORIGINATED AND DEVELOPED BY ARMCO ENGINEERS

PUT THE BRAKES ON HIGH COSTS *Save on Power!*

HIGH BLADING COST
HIGH TAMPING COST
HIGH BULLDOZING COST
HIGH PIPE LAYING COST
HIGH FINISHING COST
HIGH MISCELLANEOUS COST
HIGH SHUTTLE-MOVING COST

HD-10 HANDLES ALL THESE JOBS...



ALLIS-CHALMERS HD-10 DIESEL

ALLIS-CHALMERS

HD-10 easily handles 10 or 12-foot Leaning Frame blade graders.

No need to use bigger, higher-powered tractors on blade-grading, bulldozing, finishing, tamping and miscellaneous work. You can easily do these jobs with the HD-10 (87 drawbar h.p.)... and at considerable savings—there's less investment, less depreciation, smaller operating cost... **ADDITIONAL PROFITS FOR YOU.** There's power to spare with the heavy-duty 2-cycle Diesel engine—hangs on to overloads with tenacity of steam power. In addition, throttle control reduces gear shifting... speeds up the work. Operates on regular Diesel fuel. Investigate this power and money-saving HD-10... **NOW.** See your Allis-Chalmers dealer.

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2-CYCLE DIESEL POWER

3 SIZES: HD-7, HD-10, HD-14
60 TO 132 DRAWBAR HORSEPOWER

Power to spare... more than enough to work both ends at the same time.

^ Ideal with Gar Wood 2-wheel scrapers—fastest digging and dumping outfits available!

> 2-cycle engine purrs quietly through tough pusher work.

< Puts capacity loads in Gar Wood 8 or 10-yard scrapers.



"2 MONTHS ahead of schedule"

ON THIS 35 MILLION DOLLAR JOB

SWEET NEWS—THE HUNKIN-CONKEY CONSTRUCTION COMPANY of Cleveland is 'way ahead of time on the big U. S. shell-loading plant at Ravenna, Ohio.

"With RPM DELO—breakdowns are no longer present"—that's their report on eleven Thew Lorain shovels and 87 other pieces of Diesel equipment working a 24-hour day in rock and shale—4 million yards of it. If you ever had Diesel trouble—look at this list—all 98 pieces RPM DELO lubricated—all working fine:

- 63 Caterpillar "Cats"
- 6 small Diesel locomotives (Caterpillars)
- 5 Northwest shovels (Murphy Diesels)
- 1 Marion Shovel
- 11 Thew Shovels (Caterpillar Diesels)
- 12 Air Compressors

There are 116 miles of railroad, 70 miles of highway and 900 buildings in the contract—but with RPM DELO on the job "former lubricating difficulties have disappeared."

"Two months ahead of schedule" is a quick way of saying RPM DELO—and no breakdowns! No sludge trouble—no ring-sticking—engine wear lower than ever before!



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DIESEL ENGINE LUBRICATING OIL

ORDER RPM DELO Unequaled FOR YOUR DIESELS

Approved by the makers of over 95% of the installed Diesel horsepower in America, RPM DELO is marketed under the following names:

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Ask your Diesel engine manufacturer or distributor for the RPM DELO supplier in your locality.



STANDARD OIL COMPANY OF CALIFORNIA



THERE is no question about the economy of Bucket Loaders. For twenty years they have loaded material cheaper than any other method or machine.

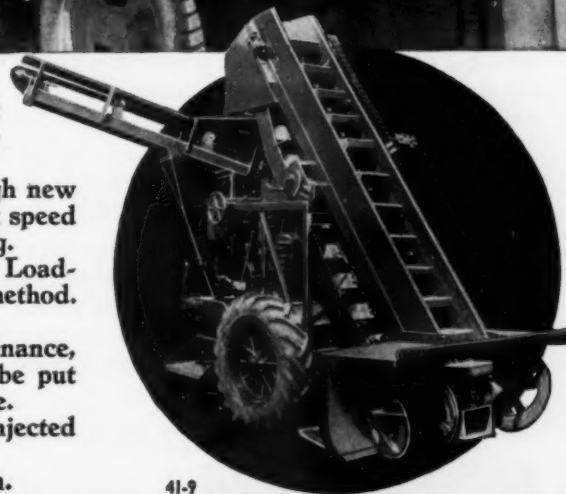
Now the B-G Model 522 offers a new economy through new portability. Not just greater ease in maneuvering—but truck speed towing—with quick and easy hitching—with no dismantling.

This new portability greatly increases the scope that the Loader can cover. It practically obsoletes every other loading method. It makes every other means too expensive.

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In addition to this new portability, Barber-Greene has injected many other new features into this ingenious design.

Write for complete information. There is no obligation.



41-9

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New, Velvety Riding Qualities Plus Historic Low Cost

Improved methods of construction in the last few years have ushered in a new era of brick pavements. These modern brick pavements have safe, velvety riding qualities plus brick's historic long life and lowest cost per year of service.

Some of these new methods are rolling on boards . . . improved mastic cushions . . . surface removal of excess filler . . . wire-cut vertical fibre lug brick . . . and vibrated monolithic brick construction for highways.

The cumulative results of these new techniques give modern brick pavements a perfect surface for any vehicle at any speed *and the surface stays that way.*

Hundreds of modern brick pavements have been built in the past ten years. They are starting towards a golden anniversary of trouble-free service. Experience says they will reach that anniversary—perhaps pass it. For all commonly used pav-

ing materials, vitrified brick has by far the greatest resistance to weather damage, which is the starting point for most paving failures.

If you would like to receive free literature on modern brick pavements and their construction, write to the National Paving Brick Association, National Press Building, Washington, D. C.

Modern Brick Pavement West 6th Street, Jamestown, N. Y. This is a resurface job.



VITRIFIED BRICK
THE MOST SATISFACTORY PAVEMENT



Better EUCLIDS ...and more of them!

A message to our customers and friends:

Improving quality and increasing production at the same time is no easy task today—but with your help Euclid is doing it.

Even before defense projects and orders dominated the scene, your steady demand for Euclids kept our factory busy. Old customers bought more Euclids . . . new customers tried Bottom-Dump and Rear-Dump EUCLIDS for the first time—and then came back for more. Equipment sales for 1940 exceeded those for 1939 by more than 50%!

Thus you made it necessary and possible to make important additions and improvements to our manufacturing plant and equipment. When

the defense rush came, Euclid was better prepared . . . trained workmen were ready . . . more machine tools were here or on the way . . . production was stepped up steadily. During the first four months of this year alone, you ordered and received two-thirds as many Euclids as during the whole preceding year. While trying to keep pace with your growing requirements, Euclid has also remembered the vital importance of quality to economical performance. The superior caliber of Euclid design, material and construction is being consistently maintained and improved. Euclid will continue to supply you with *better* EUCLIDS . . . and more of them!

THE EUCLID ROAD MACHINERY CO. • Cleveland, Ohio

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EARTH • ROCK • COAL • ORE
HAULING EQUIPMENT

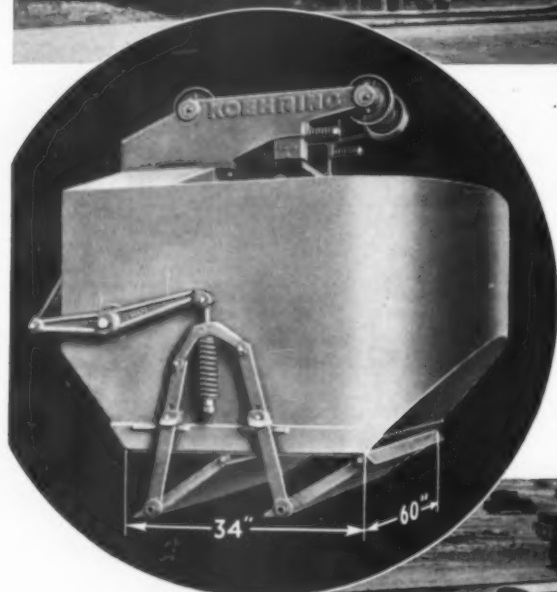
And—CRAWLER WAGONS • ROTARY SCRAPERS • TAMPING ROLLERS



New **34-E** SINGLE-BATCH!



Long boom can be swung to a 90° angle for non-tip pouring from the shoulder to grade. Air-controlled discharge chute is quick acting and positive.



Thirteen square feet of door opening permits high speed dumping and spreading.

Extra Large Opening For Fast Free Spreading

Two door distributing bucket has extra large opening . . . approximately 13 square feet . . . for fast, free flowing discharge of full batch. Both doors open same direction to provide full width of bucket bottom for easy and quick spreading.

Air controlled discharge chute is quick acting, positive and not affected by temperature changes. Air control is equally responsive at any time of the operating period. These Koehring features are only a few of the many improvements of the new Koehring 34-E Single-Batch paver . . . to provide increased speed of the batch cycle.

KOEHRING CO.

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Low overall height permits pouring and travel through underpass without dismantling.



HEAVY-DUTY CONSTRUCTION EQUIPMENT



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SHOULD BE
PRESSURE-TREATED TIMBER



ALL A TESTED STEP-BY-STEP
METHOD FOR PAINTING
CREOSOTED WOOD



HOW
PRE-FABRICATED CULVERTS
SPEED UP WORK



UNIVERSAL SPECIFICATIONS
FOR ALL TYPES
OF TARMAC CONSTRUCTION



HOW TO BUILD STEEP ROOFS
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and Economical, too

You can fit ornamental design and artistic appearance into a limited guard-rail budget, by using pressure-creosoted wood. These posts cost less than other *permanent* construction materials. They are stronger under impact. They have a lower annual cost and at the same time—as the picture above of the Brooklyn (N.Y.) Parkway installation shows—blend with their surroundings. They outlive untreated posts by many years; in states where untreated posts have lasted three, four and

six years, treated posts have already served for ten, eleven and as long as fifteen years without any signs of deterioration. They are more uniform in size, and are more easily and quickly installed. Finally, maintenance expense is greatly reduced, as no surface coatings are necessary; the treatment provides dependable protection against decay, termites, marine borers, weather, and mechanical wear. We will be glad to give you full information, if you will write.

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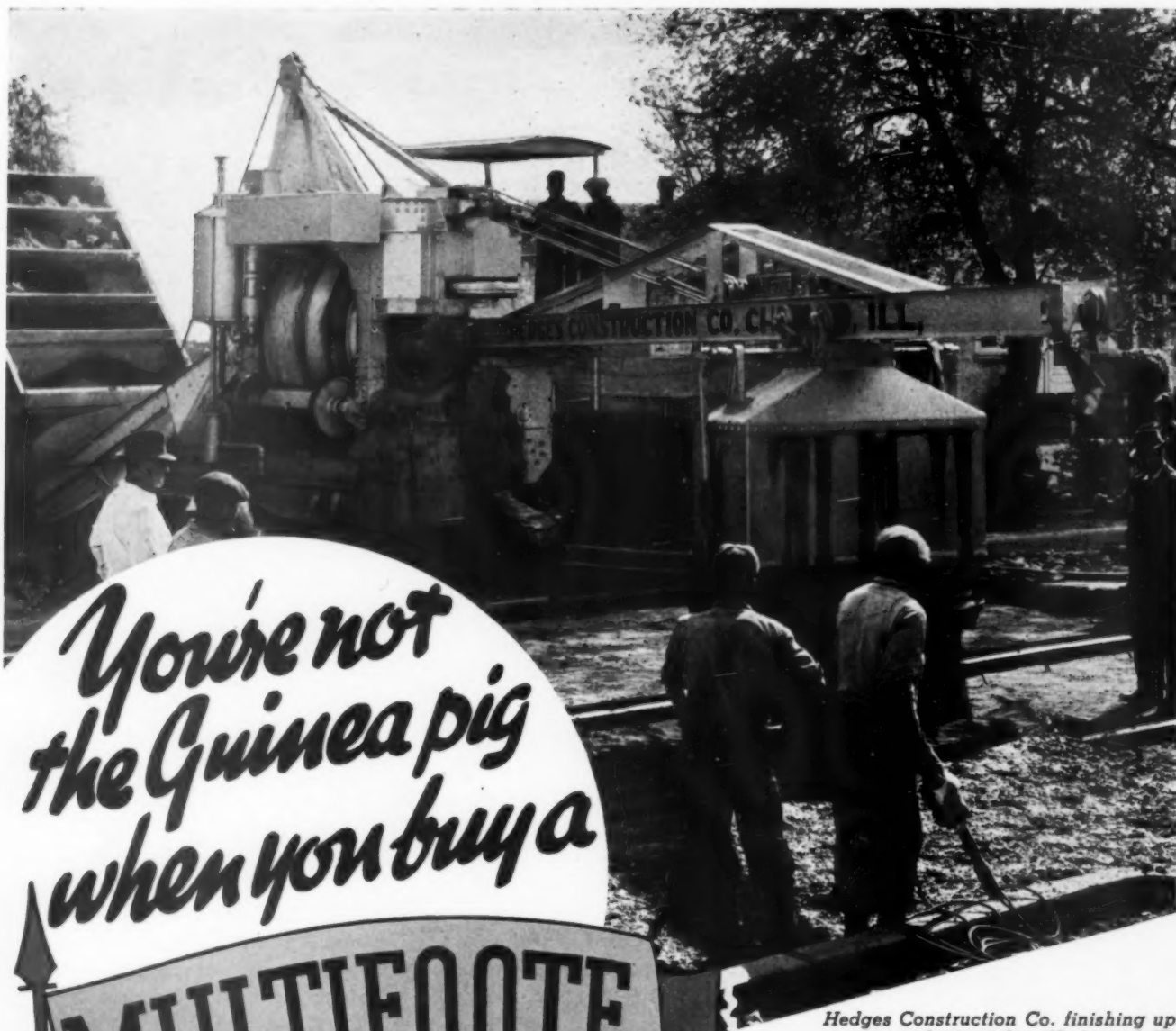
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*Fill out
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Hedges Construction Co. finishing up a street widening job in Highwood, Ill.

*You're not
the Guinea pig
when you buy a*

MULTIFOOTE *Single Drum* 34-E PAVER

And for Black Top—

The Adnun Paver gives Continuous Course Correction for smoother pavements — fast, easy operation, high output, low costs. A real money maker for roads or airports — for Black Top Paving or Rock Spreading.

the drawing boards. It's the only Single Drum 34-E with a season's proved performance behind it!

On all types of work all over the country, it has been proved that you can highball a MultiFoote 34-E day after day and it won't even whimper! There are no "bugs" in it. It has all the time-proven MultiFoote advantages plus features of its own that have stood the test of the toughest jobs. Without exception every owner of a MultiFoote 34-E has been enthusiastic about the machine—its speed, dependability and trouble-free performance.

These things count plenty when it comes to figuring paving profits. You can't afford to be the "guinea pig"—plan now to buy a MULTIFOOTE Single Drum 34-E Paver for your next job. Write today for your copy of the new 34-E Catalog.

THE FOOTE COMPANY, INC., Nunda, New York



★ Each roller in the crawler is fitted with two bronze bushings which are provided with piston type seals to guard against dirt and grit entering and ruining the bushings.

★ Lubrication of bearings is made easy through alemite fittings which extend through the ends of the axles, only a few minutes are required to service the entire crawler.

★ A simple arrangement for adjusting the crawler belt is located on the ends of the truck axles where access is easy.

★ The large diameter rollers keep the truck bushings high out of the mud. They are few in number and require less attention than the small multiple type roller.

★ The drive chains are easily adjustable and are located back under the crawler treads where they can not come in contact with obstructions of any kind.

★ The self-cleaning principle of the drive rollers, prevents mud and dirt from interfering with the propelling mechanism, thus assuring smooth, trouble-free travel at all times.

★ Extensions can be applied to the standard crawler to increase the ground bearing area and effect greater stability when machine is working on soft, uneven ground. Extensions can be applied in the field.

★ Each tread is hinged across the full width on heavy steel pins passing through multiple lugs.

Regardless of the position of the crawler belt, either crawler belt can be disengaged for turning in a wide or short radius.

The crawler truck is equipped with an efficient truck lock that prevents the machine from working back when machine is digging or working on a grade.

The LIMA crawler truck is designed for earthmovers who can not tolerate travel delays. It is strong and rugged, with speed and flexibility to enable it to master any ground condition a shovel, dragline, or crane may encounter. Make your next excavator a LIMA. You will like its ruggedness and speed and the way it can be maneuvered over rough, uneven ground and in close quarters.

LIMA LOCOMOTIVE WORKS, Inc.

Shovel and Crane Division

LIMA, OHIO

LIMA

SHOVELS - DRAGLINES - CRANES

A NEW COST DATA BOOK

Road and Street Construction Methods and Costs

BY
HALBERT P. GILLETTE
AND
JOHN C. BLACK

This book was planned and compiled expressly for use by contractors, engineers and highway officials.

It is not a textbook, but is a compendium of data carefully selected with reference to their usability by highway builders and other persons concerned with highway construction costs.

In general the data are of two main classes—dollar and cents costs per mile, per square yard, per cubic yard, and the like, for use in quick approximate estimates; and details of material, labor and equipment costs, with records of man-hours and machine-hours, for use in close estimating and in studies to reduce costs or improve methods.

The data are from a great number of different sources, and are in widely varying detail.

All major articles carry descriptions to show clearly the class of work and the methods for which costs are given, and to provide a basis for further reference and study if desired.

Location and date of job and the source of information are given in the title and introduction to each article.

The grouping of subjects in chapters is convenient, but an unusually complete index is furnished as the main guide to any subject or sub-subject sought.

The authors are both men of practical experience in highway and other construction. Both are members of the American Society of Civil Engineers.

The book is filled with useful data, and its answer to just one question may easily be worth hundreds of times its price.

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Outline of Contents

CHAPTER 1. INTRODUCTION—Brief discussions of construction costs, prices, profits and the uses of cost data.

CHAPTER 2. COST INDEXES—Indexes of the U. S. Public Roads Administration and Interstate Commerce Commission, with brief explanations of their construction, uses and limitations.

CHAPTER 3. OVERHEAD COSTS—Separate discussions of the overheads incurred by contractors and by states, counties and cities.

CHAPTER 4. ENGINEERING—Data from states, cities and other sources on the costs of various kinds of surveys and other engineering. There are brief articles on aerial surveys and seismographic soil and rock surveys.

CHAPTER 5. RIGHT-OF-WAY—A general discussion followed by records of actual experience and costs.

CHAPTER 6. EQUIPMENT—This chapter contains several rental and ownership expense schedules in full detail, followed by articles on operating and maintenance costs, including records of fuels, lubricants, etc., a mathematical analysis of the problems of selecting and retiring machines, and a table of depreciation rates.

CHAPTER 7. LABOR—Schedules of established minimum wage scales and records of wage rates in various states; comparisons of contract work and day labor; convict labor costs and other pertinent matter.

CHAPTER 8. CLEARING AND GRUBBING—Records of clearing with tractor-mounted equipment, hand and horse methods, stump blasting, etc.

CHAPTER 9. GRADING—Eighty-four pages of articles on grading with power shovels, scrapers of various types and sizes, elevators, blade graders, bulldozers, etc.; hydraulic grading; rock drilling and blasting; winter grading; special swamp grading; minor operations and hand work.

CHAPTER 10. HAULING AND HANDLING MATERIALS—Studies of hauling operations on power shovel jobs, concrete construction and bituminous construction; truck movements at yards; industrial railways; team and wagon hauling; and other articles.

CHAPTER 11. PRODUCTION OF AGGREGATES—Articles on labor requirements and costs of producing sand, gravel and crushed stone at various locations.

CHAPTER 12. UNTREATED BASES AND SURFACES—Waterbound macadam, crushed rock and gravel construction.

CHAPTER 13. STABILIZATION OF BASES AND SURFACES—This chapter is devoted chiefly to work with calcium chloride, articles on portland cement and bituminous stabilization being given in the chapters on concrete and bituminous construction.

CHAPTER 14. BITUMINOUS SURFACES AND BASES—The five parts of this long chapter contain articles on various methods in different states. Part 1, Surface Treatments; Part 2, Bituminous Macadam; Part 3, Mixed-in-Place Construction; Part 4, Travelling Plant Construction; Part 5, Stationary Plant Construction.

CHAPTER 15. CONCRETE SURFACES AND BASES—Contains numerous detailed records of construction. There are articles on work with 27-E pavers, 34-E pavers, tandem set-ups, batching, hauling, curing, joints, cement-bound macadam, soil-cement roads, stabilization, and other subjects.

CHAPTER 16. BRICK PAVEMENTS—Records of brick pavement construction from various cities and states, including an article on vibrated monolithic. Short references to granite block.

CHAPTER 17. SIDEWALKS, CURBS AND GUTTERS—Miscellaneous prices and details of construction.

CHAPTER 18. WALLS, FENCES AND GUARD RAILS—A brief chapter of data on these items of highway construction.

CHAPTER 19. BRIDGES AND CULVERTS—Cost data on a large number of steel, concrete and timber bridges and grade separations—also culverts of various types. There are two articles on pump installations for underpass drainage.

CHAPTER 20. TUNNEL CONSTRUCTION—Detailed descriptions and data on the construction of 27 highway tunnels in the West.

CHAPTER 21. GRASS, SHRUBS AND TREES—Several articles on plantings for landscape improvement and bank protection.

CHAPTER 22. MISCELLANEOUS—Data on pedestrian underpasses, street car loading platforms, truck weighing stations, catch basins and manholes, lignin binder, water pumping, signs and markers, traffic striping, parking meters, highway lighting, radio communication with snow plows, accident prevention, and weather and construction.

INDEX—Unusually complete; arranged for quick reference and maximum convenience.

ARE YOU MAKING *a Donation* AGAIN THIS YEAR?



HOW much money are you going to sink into excess aggregate through loss of yield on poorly prepared subgrade this year? It costs you plenty if you make the slab too thick and in most states you pay if the slab's too thin — you're between the devil and the deep, and you lose either way!

But Buckeye R-B Power Finegrader owners don't suffer these losses — and they use less labor and never hold up the paving crew because their Finegraders move out fast and cut the grade *right on the payline!* Smooth, accurate and true. No low or high spots that spell trouble and money!

Stop the "Donations" and make bigger profits this year on concrete or macadam jobs with a Buckeye R-B Finegrader. A size for every job — 8' to 24'. WRITE FOR 8 PAGE BULLETIN NOW! BUCKEYE TRACTION DITCHER COMPANY, Findlay, Ohio.



READ What These STATE HIGHWAY ENGINEERS Have to Say!

"... loss of yield would probably range from five to ten percent, and this is largely attributable to extra slab thickness." — *Engineer of Construction.*

"... we do know that contractors have lost considerable in yield because of not having subgrade properly prepared." — *Chief Engineer.*

"Overruns vary from an average of 1½% to as high as 8%. Where overruns occur they are generally the result of low subgrade and excessive thickness of pavement." — *Engineer of Materials and Tests.*

"Smoothness and trueness of subgrade are necessary, desirable and required, ... the method chosen is that which works out to the best advantage of the party contracting to do this work." — *Construction Engineer.*

Built by Buckeye

Convertible Shovels



Trenchers



Tractor Equipment



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Road Wideners



Spreaders



IT'S GOT THE **EXTRAS**

TO MOVE MORE MATERIAL, FASTER, AT LOWER COST

**EXTRA
POWER!**

**EXTRA
CAPACITY!**

**EXTRA
STRENGTH!**

**EXTRA
SERVICE!**

Power gets full priority in Lorain-40A design. It is transmitted from the motor by a multiple roller chain *directly* to the Center Drive pinion; from here power flows *directly* into hoist and swing (or travel) shafts. Full engine power is yours to command—concentrate it on any one operation to tame the tough jobs or spread it over simultaneous and synchronized operations to obtain powerful high speed working cycles.

This 3/4-yd. machine does more work for its weight. That's because the patented Sloping Machinery Frame concentrates the machinery farther back of the tipping point, converting it into "live counterweight" to give the greatest counter-balancing effect.

Center Drive design boils construction down to essentials only. Parts are fewer, therefore they can be made larger and stronger. That's why double shifting and tough digging won't faze the "40A".

You can hang any type of boom—shovel, crane, clamshell, dragline, backdigger or skimmer—on this 3/4-yd. machine with the same satisfactory results. It's really 6 machines in 1 and that means you can always keep the Lorain-40A busy—profitably.

Complete information on these and many other features are contained in new Lorain-40A catalog. Get your copy now.

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LORAIN, OHIO**

2 of 8 Lorains for Vandigriff Construction Co.,
Alabama.



**3/4 YD.
LORAIN
40A**

ROADS and STREETS

Vol. 84, No. 7

July, 1941

A GILLETTE PUBLICATION

ESTABLISHED 1906

SIX MILES OF PULASKI ROAD WIDENED AND REPAVED

*Four Contracts Now in Progress Practically Complete
Improvement of One of Chicago's Most Important
North-South Arteries*

By MALCOLM V. BURTON

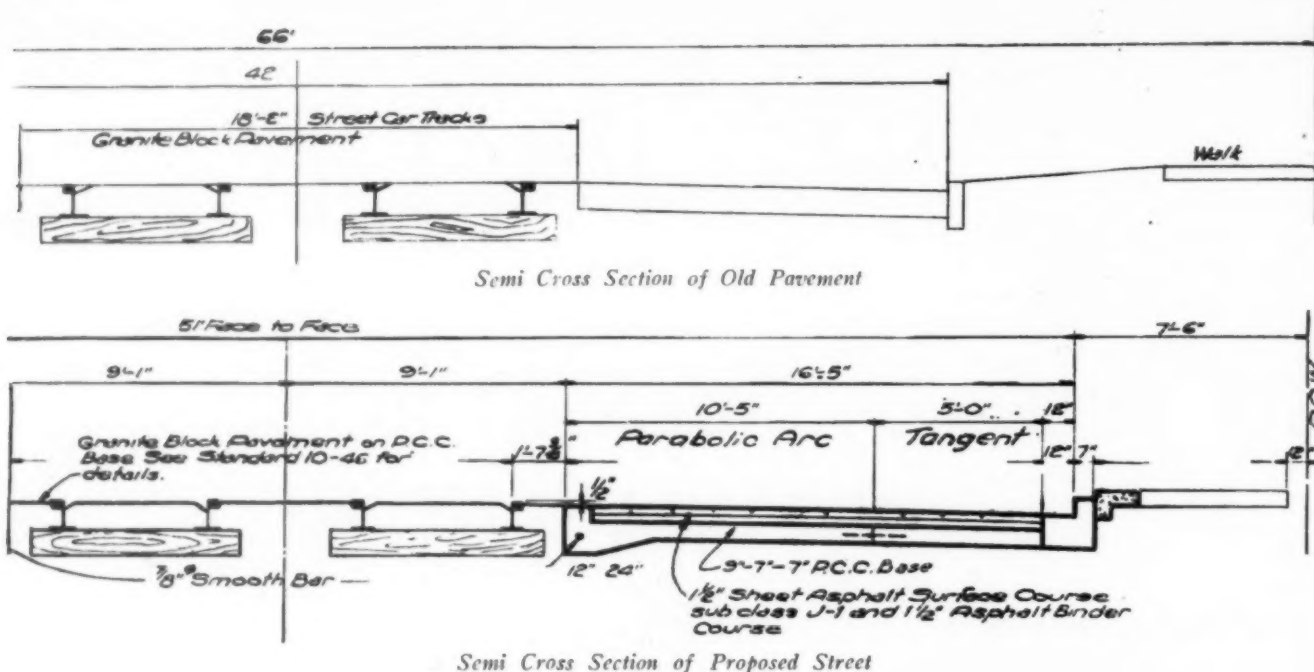
Associate Editor

WHEN Rock Road Construction Company of Chicago bid on the improvement of Pulaski Road now under way, they understood the difficulties that confronted them. However, it is doubtful if they or any other experienced contracting organization could foresee all of the minor irritations that were to be encountered. Nearly every job has "its moments" that

cause the management to age measurably before things get going on even keel but this project had more than its share. On their contract Rock Roads Construction Co. handled the work with both fortitude and finesse and performed at their own expense many operations not required by the contract. This additional work was purely for the benefit of the public.



Rock Road Construction Company's Multi-Foote Paver Laying P.C.C. Base Course on Pulaski Road at the Intersection with Washington Blvd. This Outfit Could Lay 1,500 Feet Per Day Working in the Country. On This Job 1,250 Feet Was an Average Run for 8 Hours in Spite of the Interruptions Caused by Heavy Traffic and Delays in the Supply of Materials



Northwest Shovel Is Removing the Old Brick Pavement with Its Concrete Base from the West Side of the Street. Excavation Presented One of the Toughest Problems on This Job



The Public Utilities Had to Put in Many Laterals, All Trenches Being Excavated by Hand. According to Specifications All Back Fill Was of Sand

The funds were provided from the county's share of the gas tax which means that the plans had the approval of the Illinois state highway department and that state specifications were in force.

The work on Pulaski Road (formerly Crawford Avenue) consists of approximately six miles of widening and repaving. The improvement was undertaken by the county to relieve traffic congestion between Belmont Avenue on the north and 26th Street on the south. When completed, this street, state aid route 51, will be one of the longest improved North and South routes in Cook County, Illinois. Only one short gap remains to be paved in its entire length.

Generally speaking, the work consisted of removing the old brick pavement on both sides of the car tracks and replacing it with a new pavement approximately $4\frac{1}{2}$ feet wider on each side giving a width of 51 feet from face to face of curbs. The additional width of the street will permit automobiles to pass street cars when other automobiles are parked parallel with the curb. The type of pavement chosen was sheet asphalt on a concrete base. One reason for this choice is that the street is frequently torn up and this type of pavement can be repaired in a more satisfactory manner than some others. Among the many other improvements was the widening of the 90° curve at Beldon Avenue where the C. M. & St. P. R. R. crosses Pulaski almost at the street intersection. The new construction will permit street cars and motor vehicles to operate around the curve without interfering with one another.

Pulaski Road is an old street as far as major arteries in Chicago are concerned. It would take too long to tell exactly what has been done to it throughout the years. However, to fully understand what the contractors encountered it is necessary to explain that years ago when some of the utilities were installed many of the pipes and conduits were placed barely under the ground. At that time this teeming area of Chicago's great west side was open country and no one could foresee the rapid growth of the neighborhood.

Close Bidding and Low Prices

To facilitate the work the six miles of improvement was divided into 4 contracts of approximately $1\frac{1}{2}$ miles

each. These were awarded at a letting held in the early fall of 1940. Close bidding was the order of the day. Union Contracting & Paving Company was low bidder on the section from Cermak Road to Harrison St. at \$229,890.37, Rock Road Construction Company from Harrison Street to Chicago Avenue at \$223,009.43, Standard Paving Company from Chicago Avenue to Armitage Avenue at \$223,768.82, and Midwest Construction and Asphalt Company from Armitage Avenue to Belmont Avenue at \$223,250.12. The Rock Road contract has been chosen for description because it lies in the most congested business area. A tabulation of the three low bids on this section given elsewhere indicates the close bidding and sound prices that prevailed.

Much Underground Work

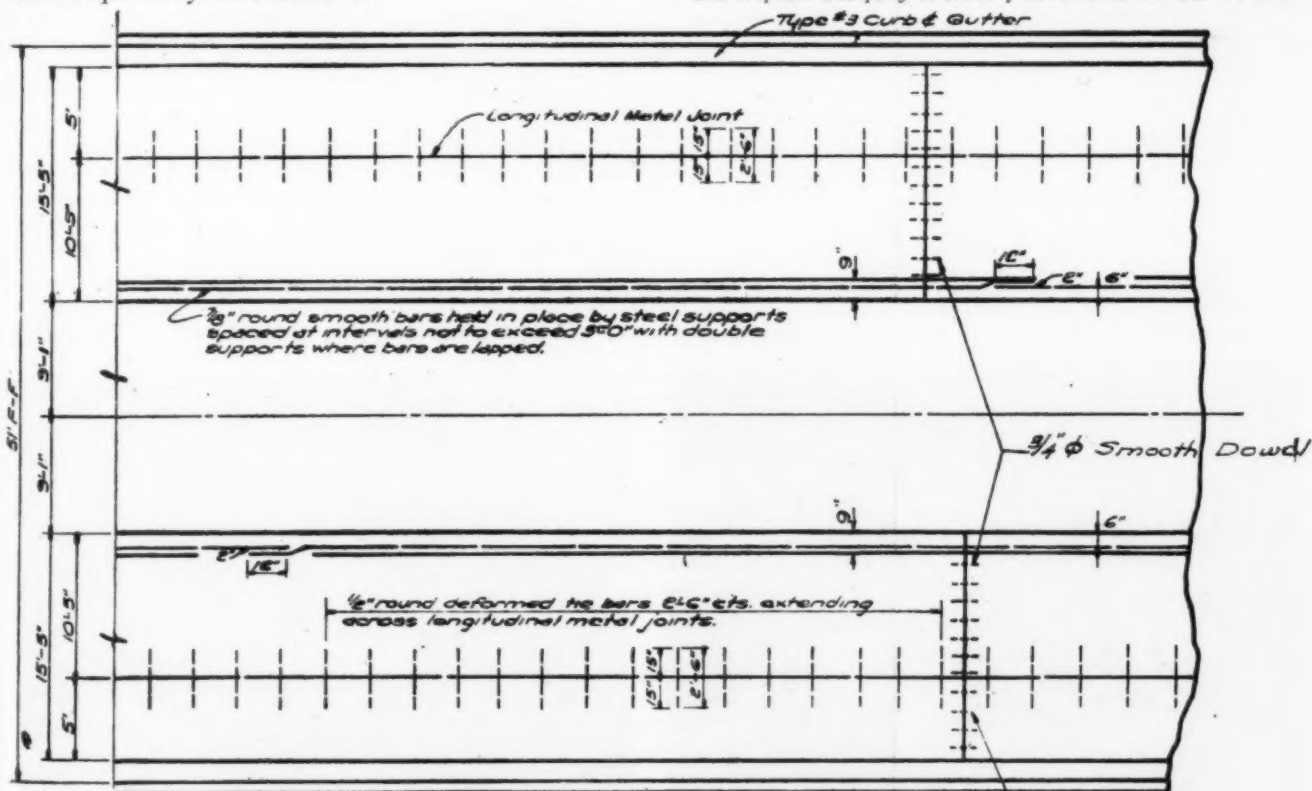
The contractor's forces could not commence work until April 20th of this year, when some of the work on the underground utilities had been finished. This work was considerable. In addition to rehabilitating existing mains and services the Water Pipe Extension Division of Chicago laid some new 12-inch and 8-inch mains. There were 12 hydrants, 82 shut-off boxes, 15 meter vaults, and 69 valve basins to adjust, the cost of which was included in the contract price. The Department of Streets and Electricity had to move the lighting and fire alarm equipment on the trolley poles in conjunction with the Chicago Surface Lines when the trolley poles were moved back of the proposed curbs. The Chicago Park District had to move poles, traffic signals and perform other work. The People's Gas Light & Coke Company recalked all of their mains. The Commonwealth Edison Company rebuilt manholes and extended laterals at many locations as did the Illinois Bell Telephone Company. The Chicago Surface Lines in addition to moving their trolley poles and their feeder cable system had to extend laterals and adjust the track brow when required by the contractor.



Three of the Men Directly Responsible for the Work Are in the Group of Five Facing the Camera. From Right to left: Earl De Mara, Paving Foreman; William Figg, Resident Engineer; and Ralph Petrie



The Koehring Dual-Drum Paver of The Midwest Construction and Asphalt Company Worked from Across the Car Tracks



Note:—Maximum length of $\frac{3}{8}$ " bar permitted = 30 ft.
Bars shall be lapped 12 inches

Plan for Base Under Bituminous Pavement

TABULATION OF 3 LOW BIDS—SEC. 051-2728-15D
PULASKI ROAD IMPROVEMENT

			Rock Roads Const. Co. 5915 Rogers Ave. Chicago, Ill.		Union Const. & Eng. Co. 30 N. La Salle St. Chicago, Ill.		Midwest Const. & Asphalt Co. 221 N. La Salle St. Chicago, Ill.	
Quant.	Item	Unit	Unit Price	Total	Unit Price	Total	Unit Price	Total
27,788	P.C.C. Base Course	Sq. Yds.	\$ 1.25	\$ 34,735.00	\$ 1.28	\$ 35,568.64	\$ 1.27	\$ 35,290.76
1,008	P.C.C. Pavement	Sq. Yds.	1.43	1,441.44	1.40	1,411.20	1.42	1,431.36
1 892	Granite Block Pavement on P.C.C. Base	Sq. Yds.	8.25	15,609.00	8.00	15,136.00	8.10	15,325.20
26,475	Sheet Asp. Surface, Sub Cl. J1.....	Sq. Yds.	1.09	28,857.75	1.03	27,269.25	1.15	30,446.25
1,986	Asp. Binder Course	Tons	9.05	17,973.30	9.00	17,874.00	9.10	18,072.60
14,926	Com. Conc. Curb & Gutte-, Type 3.....	Lin. Ft.	.90	13,433.40	.85	12,687.10	.90	13,433.40
375	Plain Concrete Curb, Type 4.....	Lin. Ft.	.80	300.00	.90	337.50	.85	318.75
1,008	Pavement Fabric	Sq. Yds.	.18	181.44	.20	201.60	.16	161.28
15 000	P.C.C. Sidewalk	Sq. Ft.	.24	3,600.00	.25	3,750.00	.26	3,900.00
14,250	Special Sidewalk, Type 1.....	Sq. Ft.	.31	4,417.50	.34	4,845.00	.35	4,987.50
60.61	Class X Concrete.....	Cy. Yds.	40.00	2,424.40	50.00	3,030.50	45.00	2,727.45
5,015	Reinforcement Bars	Lbs.	.05	250.75	.06	300.90	.04	200.60
7,775	Bit. Long Curb Exp. Jt. 1".....	Sq. Ft.	.23	1,788.25	.23	1,788.25	.23	1,788.25
12,346	Special Excavation	Cu. Yds.	1.10	13,580.60	1.20	14,815.20	1.15	14,197.90
900	Trench Back Fill	Cu. Yds.	2.50	2,250.00	2.00	1,800.00	2.50	2,250.00
14	Sand, Gravel or Crushed Stone Backfill.....	Cu. Yds.	2.00	28.00	2.00	28.00	2.00	28.00
1,724	8" Storm Sewer, Type 2.....	Lin. Ft.	2.00	3,448.00	1.65	2,844.60	2.10	3,620.40
15	8" Storm Sewer, Type 1.....	Lin. Ft.	1.40	21.00	1.50	22.50	1.60	24.00
892	8" Storm Sewer, Type 2.....	Lin. Ft.	2.20	1,962.40	2.00	1,784.00	2.00	1,784.00
105	Catch Basins, 48".....	Each	85.00	8,925.00	95.00	9,975.00	80.00	8,400.00
95	Filling Catch Basins	Each	10.00	950.00	10.00	950.00	10.00	950.00
3	Inlets	Each	\$50.00	\$ 150.00	\$48.00	\$ 144.00	\$50.00	\$ 150.00
61	Filling Existing Inlets.....	Each	5.00	305.00	10.00	610.00	7.00	427.00
2	Manholes, 36".....	Each	80.00	160.00	90.00	180.00	70.00	140.00
33	Drain Structures to be Adjusted.....	Each	14.40	475.20	14.50	478.50	14.20	468.60
30	Drain Structures to be Reconstructed.....	Each	16.00	480.00	20.00	600.00	18.00	540.00
33	C. I. Frames and Grates.....	Each	15.00	495.00	16.25	536.25	17.00	561.00
2	Section Markers	Each	15.00	30.00	20.00	40.00	20.00	40.00
Lump Sum	Adjusting Water Equip.			8,905.00		8,905.00		8,905.00
Lump Sum	Adjusting Elec. Equip.			24,500.00		24,500.00		24,500.00
77	Light Poles Removed.....	Each	10.00	770.00	10.00	770.00	10.00	770.00
77	Light Poles Reset and Rewired.....	Each	45.00	3,465.00	50.00	3,850.00	40.00	3,080.00
8	Barricade for Widening, R. R. Ties.....	M. F.	35.00	280.00	40.00	320.00	40.00	320.00
11,750	Portland Cement	Bbls.	2.28	26,790.00	2.28	26,790.00	2.25	26,437.50
30	Concrete Header	Lin. Ft.	.90	27.00	1.00	30.00	1.10	33.00
				\$223,009.43		\$224,172.99		\$225,709.80

The Executive Committee of the Board of Underground Work of Public Utilities of Chicago prepared a schedule of the work which was adopted at the meeting of October 16, 1940. Delays were inevitable and came from unexpected quarters as usual.

Excavation A Major Problem

As already explained many of the underground utilities were very close to the surface of the ground which made the excavation of the old pavement a ticklish proposition.



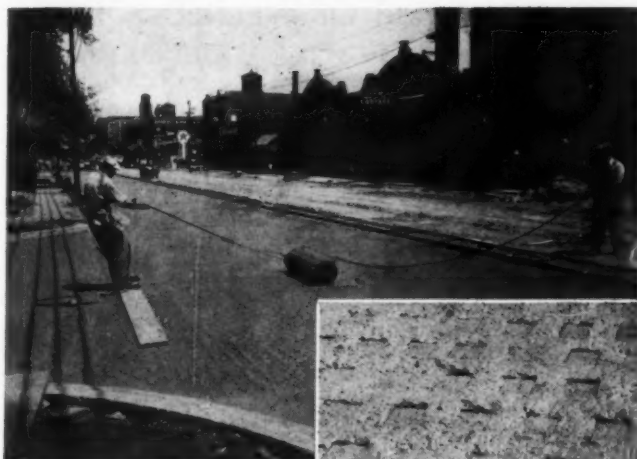
A Motor Patrol Was Used Between the Forms

As you will see from the cross section, the new pavement followed the parabolic curve of the old pavement to the old curb line and was then continued on a tangent. At the curbs and at times in the middle of the street the shovel was digging far enough down to hit pipes and conduits besides having to dodge manholes, catch basins and "what have you" that showed up on the surface.

And so during the excavation the street was full of inspectors each with his blueprint to inform the contractors just what to expect. Believe it or not, there were



Rolling the Finished Grade. The Paver Is About a Block Behind



Standard Practice on This Work Is to Roll the Base with What the Men on the Job Call a Modified Sheepfoot Roller. It Leaves Indentations That Keep the Surface from Creeping



The Reinforcing Bars That Tied the Curb and Gutter to the Base Are Being Straightened Out by This Workman. For Full Explanation See Text

as many inspectors as workmen. Here is the lineup for the contractor. Shovel operator, oiler, two laborers, and 5 or 6 truck drivers. The inspectors were from the Water Pipe Extension Division, Commonwealth Edison, Illinois Bell Telephone, People's Gas Light & Coke, Chicago Park Districts, Chicago Surface Lines, Chicago Sewer Department, the County Highway Dept., the State Highway Dept., and the C. & N. W. R. R., the last mentioned to protect the ground wire of the railroad's signal system at the Kinzie Street viaduct.

A pleasant time was had by all, especially the day the trolley wire was knocked down during the morning rush hour and 22 street cars were stalled in practically no time at all. This tie up was of very short duration and not serious. However, it was serious when a live conduit was encountered at the edge of the side walk south of Madison Street. The trolley poles could not be set in their new locations until a saddle support for each of 16 poles had been designed and approved. Also at the corner of Madison Street a Commonwealth Edison vault, which was under the side walk, found itself out in the street because of the widening. This vault contains the largest transformer in Chicago outside the Loop. The roof of the vault became the surface of the street and had to be rebuilt and strengthened accordingly.

These and other unexpected happenings resulted in the job being about 40 days behind schedule on June 25. However, by that time the worst was over and the contract should be completed about August 1.

The excavation was made more difficult because of Chicago's well known blue clay and then there was the problem of material disposal always present in city work. As usual, a long haul was necessary.

Special Services Unappreciated by Public

According to the specifications, traffic had to be maintained at all times and one-half of Pulaski Road kept open. Excavation started at the north end of the job and proceeded rapidly, but the paving was held up by delays in moving the utilities which was very bad for the local business houses, and the public riding the street cars or crossing the street. In this emergency Rock Road Construction Co. did much more than was required in order to help the public. Screenings were purchased at \$1.00 per yard and placed at entrances of garages, filling stations, funeral parlors, alleys, and cross walks so that some semblance of "business as usual" could be maintained. Special platforms were built and placed at the disposal of the street car lines to aid passengers entering



Setting Forms for the Integral Curb Next to the Car Tracks. A 40-foot Vault Is Just in Front of the Building Entrance

and leaving cars. All of this came out of the contractors' pocket, but it is doubtful if any great number of the people in the vicinity felt that a real service had been rendered. Their utter lack of appreciation was probably best shown by the number of barricades and flares that walked off the job all by themselves. It is remarkable how such inanimate objects can move around.

But the money spent to providing the screenings was not entirely lost. Blue clay that has dried in lumps can be worked to an adequate subgrade surface but it requires a lot of labor. Some of the original cost of the screenings was saved simply by hauling the lumpy material out, and back filling with the screenings which greatly reduced the labor required. A much better job resulted as well.

Integral Curb Along Car Track

The design of the slab called for an integral curb on the inside next to the car tracks. This curb was built much heavier than called for in Illinois state specifications to provide additional support to the pavement edge because of the heavy traffic.

Two other features somewhat out of the ordinary, although not new by any means, are found on Pulaski Road improvement. The top of the concrete base is indented by rolling with a modified design of a sheepfoot roller operated by hand. These indentations prevent the surface courses from creeping. The handling of the steel used to tie the new curb and gutter to the base is



This Tractor Scoop Was Invaluable in Loading Excess Material Left from Excavations for the Utilities



Sheet Asphalt Being Laid on The Midwest Construction and Asphalt Company's Section. This Is Typical of All Contracts on Pulaski Road

not seen often. The reinforcing bars are delivered bent in the middle to a right angle. On one end the steel setter slips a heavy paper sleeve that is tacked to the inside of the form. The other end is supported by a metal pin. After the forms are removed, a workman with a pick digs out the sleeved end of the reinforcing rod imbedded in the concrete and straightens it out. This operation is shown in one of the illustrations.

Unfortunately, pictures are not available showing excavation or paving operations under the "L" structure at the intersection with Lake Street or under the C. & N. W. R. R. viaduct at Kinzie Street where lack of head room or room to swing the dipper made a lot of hand work necessary. The slab had to be wet-batched and placed with buggies at both locations, as did the retaining walls on both north and south approaches to the viaduct.

Special mention should be made of the difficulty experienced removing the brow pavement against the car tracks. It was tough to get out and equally tough to replace with new granite blocks.

All of the major pieces of equipment are shown in the illustrations as are the men intimately connected with the Rock Road contract. The work was performed under the supervision of George A. Quinlan, County Supt. of Highways; Duncan Campbell, Chief Engineer, and L. J. Ryan, Assistant County Highway Engineer in charge of construction. Clayton Smith is Chairman of the County board.

FATIGUE TEST OF WELDED JOINTS

One of the deterrents to the use of welds as a means of fabricating bridges has been a lack of knowledge of the fatigue strength of welded joints. Engineers accustomed to thinking of the static strength of carbon structural steel as being of the order of 63,000 lb. per sq. in., and of the fatigue strength of machined specimens of the same material as being of the order of 47,000 lb. per sq. in., were disturbed by reports of early European tests showing a fatigue strength of structural members connected by welds as low, in some instances, as 15,000 lb. per sq. in.

The situation indicated clearly that fatigue tests of welded joints, as large as it was feasible to test, would have to be made before American engineers would consider fabricating bridges by welding.

Realizing this situation, the Welding Research Committee of the Engineering Foundation organized a committee, known as Committee F, to plan and carry out an investigation such as appeared to be necessary.

Bulletin No. 327, "Fatigue Tests of Welded Joints in Structural Steel Plates," by Wilbur M. Wilson, Walter H. Bruckner, John V. Coombe, and Richard A. Wilde, which has just been issued by the Engineering Experiment Station of the University of Illinois, is a progress report of the resulting investigation.

The tests described in this bulletin were planned to determine the following:

- (1) The fatigue strength of butt welds in $\frac{7}{8}$ -in. carbon-steel plates of structural grade;
- (2) The relative fatigue strength of welded and riveted joints in low-alloy plates of structural grade;
- (3) The effect of frequent periods of rest upon the fatigue strength of butt welds in carbon-steel plates of structural grade.
- (4) The effect of transverse fillet welds upon the fatigue strength of plates.

Three ranges of minimum to maximum stress were used in this investigation:

- (1) From a given tensile stress to an equal compressive stress;
- (2) From zero stress to some given tensile stress;
- (3) From a given tensile stress to a tensile stress one-half as great.

The fatigue tests were supplemented by static tests and metallurgical studies.

All tests were made in the Talbot Laboratory at the University of Illinois.

Until November 15, 1941, or until the supply available for free distribution is exhausted, copies of Bulletin No. 327 may be obtained without charge upon application to Engineering Experiment Station, Urbana, Illinois.

Minnesota Rural Roads.—Minnesota has 109,234 miles of strictly rural roads of all classes, according to road inventory data made public by the Highway Planning Survey of the State Highway Department and the U. S. Public Roads Administration. The total is less than some formerly used figures on Minnesota road mileage, due to the fact that the official inventory omitted all abandoned roads, and all roads once legally established but never improved nor traveled.

GOVERNOR O'CONOR APPOINTS DEAN STEINBERG

Dean S. S. Steinberg of the College of Engineering of the University of Maryland was appointed by Governor Herbert R. O'Connor of Maryland a member of the State Board of Registration for Professional Engineers and Land Surveyors for a five-year term.

BUILDING NEW FILLS ON OLD FILLS

Best Results Obtained By Ponding the Cuts

By J. FRANCIS BARCLAY and PAUL S. WALL

*Senior Engineer and Associate Engineer,
Kansas State Highway Commission*

U. S. HIGHWAY 36 through Kansas was being concentrated on in last year's state road building program. A bad section beginning at the intersection of K-23 and U. S. 36 at the northwest corner of Oberlin, Kan., and running nine miles east on U. S. 36 need special attention. The construction on the project presented some very interesting problems. The nine miles called for 800,000 cu. yd. of excavation; 590,000 cu. yd. of compacted fill; four bridges and numerous culverts. An old alignment was followed, thus making it necessary to build the new fills on the old fills and to widen and deepen the old cuts. The extremely hot, dry weather and dust were factors the contractor had to combat in the progress of his work. The total precipitation for the 18 months the project was under construction was 14 in.

H. J. Hall Construction Co. of Manhattan, Kan., had the earthwork and culvert contract and Ottinger Brothers of Hinton, Okla., had the bridge contracts. Most of the excavating work was done with two 20 cu. yd. and two 12 cu. yd. scrapers. The compacting equipment consisted of two double drum sheepfoot rollers pulled by Allis Chalmers L tractors. Caterpillar RD 7's and RD 8's were used on the scrapers. This heavy equipment helped get the required compaction.

Compaction Requirements

Compaction requirements specified that the contractor should compact the fill quantities to a density equal to or greater than 90 per cent of standard compaction as specified in "Kansas Standard Specifications of 1937." This meant adding much moisture to the soil. A 4 in. pipe line with booster pumps was laid the entire length of the project and water was pumped from the city of Oberlin. A very light soil, Colby silt loam horizon 1 and 2, was encountered on the project. Moisture found in the excavation averaged about 8 per cent, making it necessary to use about 25,500,000 gal. of water or approximately 43 gal. per cubic yard of fill material, as part of this water was lost by evaporation. Moisture for maximum compaction was 19 per cent and the soil compacted best with this moisture content. The best results were obtained when the cuts were ponded and let set for from 4 to 6 weeks before excavation. The ponds were constructed with a 12 ft. blade and bulldozer, being about 12 ft. square. They were filled twice and then left. This moisture would distribute itself evenly down into the soil for a depth of about 8 to 10 ft. Some cuts had to be ponded several times depending on the depth of cut. Ponding was carried on 24 hours a day. This procedure was followed in all of the deep cuts.

Moisture that could not be added in the cut as in the case of a shallow cut in which the amount of water could not be governed, was added on the fill. A tank truck with sprinkler attachment and three long hoses connected to the 4 in. pipe line were used to add moisture on the fill. It was very difficult to get just the right amount of moisture evenly distributed over a fill by this method. The watering equipment interfered with the

hauling and blading equipment except on a very long fill. The moisture was difficult to mix with the dry soil. Mixing was accomplished by continuous blading and rolling with sheepfoot rollers. Wetting and mixing the material on the fill required about twice the rolling equipment as did using material that had the proper moisture previously added in the cut.

Fill Construction Methods

The procedure followed in constructing a fill was to first backfill the culvert to the original ground line, bringing it up in layers to the required density. The second step was to remove all debris and then scarify and wet the top soil, thereby insuring a bond between the old soil and the new. Material was then deposited and bladed into layers which would average about 6 in. after compacting. Where an old fill was encountered, the side slopes were scarified to a depth of a foot or more to insure a bond between the old fill and the new. Between lifts the surface was sprinkled if it had dried out.

Foundation treatment was called for in all places where the finished fill was 2 ft. or less. Compaction of the foundation treatment was obtained in most places by ripping up the subgrade and wetting it thoroughly to a depth of 6 in. and then letting the hauling equipment compact it as they hauled over it in bringing up the fill. The same procedure was followed in the cut sections.

A grading inspector was kept on the work at all times to make compaction studies and to get a test for each 500 cu. yd. of fill placed. The relative compaction for the entire project averaged 94 per cent.

The fill slopes are solid and should weather well. The cut slopes are 2:1 to 6:1 with diversion ditches at the top of the slope where necessary to prevent erosion of the slope. The guard fence and guide posts were set to grade with no fear of settlement affecting their line. The ditches are protected from erosion by ditch checks made from cement stabilized soil in burlap bags and placed wherever the ditch grade was over 2 per cent. The entire roadbed is smooth and solid and construction of a bituminous mat surface has been completed.

7,634 Cu. Yds. Concrete Placed in 24-Hour Day.—

On March 23 Griffith Co. and Bent Co., contractors for the Friant Dam of the U. S. Bureau of Reclamation poured 7,634 cu. yd. of concrete—enough to pave more than 3 miles of standard 2-lane highway.

Motor Vehicle Registration Increased 4.7 Per Cent.

—A total of 32,452,861 motor vehicles were registered in the United States in 1940. This is an increase of 1,442,991 over 1939.

\$17,000,000 W.P.A. Funds for Access Roads.—

On June 22 work was under way on access road projects calling for expenditure of over \$17,000,000 in W.P.A. funds.



Tearing Out Old Pavement North of Speed.
Broken Slab for Rip-Rap.



One of Five Bridges Being Rebuilt South of Seymour.



Preparing to Build Curb in Austin-
Note Reinforcing Tie Loops



Cross-Over On Dual Lane Pavement
South of Greenwood.



Finishing Lip Gutter Along New Pavement

INDIANA BUILDS *Strategic Road*

WIDENING and relocation from Sellersburg to Memphis, easier grades and curves at the Coffee-pot and Apple Market hills, curb and gutter through Uniontown, widened pavement and shoulders north to Seymour, a by-pass at Columbus, and dual-lane pavement from Greenwood to Indianapolis—thus Indiana is streamlining U. S. 31 for traffic in time of peace or war.

One hundred and ten miles of highway, connecting Indiana's capitol with the winding Ohio River and with Louisville, Route 31 is a part of the network of strategic routes established by military authorities. For almost half this distance men and machines are at work, fitting the highway for the growing peacetime traffic and for the needs of war. More than two million dollars—the tax on nearly fifty million gallons of gasoline in Indiana—is financing the modernization of this highway.

Sections "Supered"

Fifty-two miles of 22-foot pavement north of Seymour, ten miles of dual-lane pavement south from Indianapolis, the by-pass at Columbus—these will speed up the automobiles and trucks which shuttle back and forth by the thousands day and night. They will also speed up the movement of mechanized army units between Fort Harrison and Fort Knox.

Widening of pavement, shoulders, and the roadway through bridges along with the increased sight distance are the result of engineering for the safety of the growing army of motorists.

This streamlining of U. S. 31 for modern traffic—one of more than a dozen such programs initiated by the State Highway Commission of Indiana—began months ago.

Construction of the dual-lane road into Indianapolis from the south marks the last of a series of projects through a ten-year period in providing adequate entrances and exist for traffic on the major state highways at the capitol city. Built entirely on relocation it bypasses the thickly populated suburban area south of Indianapolis and the narrow route through the town of Greenwood. Eventually this dual-lane section will be carried farther south, in all likelihood by-passing Franklin where a twisting route and local traffic impede through passenger and commercial vehicles. At present the ten miles of brick pavement between Greenwood and Franklin is being widened to 22 feet and will be resurfaced.



Sodding Crew at Work Near Scottsburg

"SUPER" INTO U.S.-31 Is Strengthened

The twenty-odd miles of Route 31, south from the end of the present dual-lane section to the north end of the Columbus by-pass, now under construction, remains to be included in the streamlining program for Route 31 south of Indianapolis. Abandonment of the interurban line, now operating one car daily between Columbus and Indianapolis, will make needed right-of-way available at some points along this section where it parallels the highway.

The by-pass for Route 31 around Columbus, now under construction, is a part of the "streamlining" program which began several years ago when this road was extended north from its intersection with Route 50, east of Seymour, eliminating the movement of through traffic through Seymour. The by-pass around Columbus will mean another speeding up of through traffic movement. The 15 miles of Route 31 between Road 7 and Route 50, completed in 1933, was designed for present traffic needs in width and alignment.

From the junction with Route 50, east of Seymour, Route 31 has been undergoing a complete overhauling south to New Albany and Jeffersonville on the banks of the Ohio River.

This began with the widening to 22 feet and resurfacing of such sections as had satisfactory grade and alignment, work done under the supervision of the maintenance department of the state highway commission. After these projects were completed, the remainder of the streamlining job was turned over to the construction department.

Stability Problem Encountered.—Two sections of road offered problems of interest to the engineers. When the old pavement was laid through the Muscatatuck River bottoms north of Austin, a fill was built to put the road above high water at two points. These fills were built by drag line, dirt being taken from the bottom along the route and dumped in place. Although these fills had been built more than twenty years, they retained a rubbery consistency and a spongelike ability to hold moisture.

Two methods of treatment for building more stability into the fills were adopted by construction engineers. One fill was widened from a surface width of 25 ft. to 44 ft. A subgrade treatment of nine inches of No. 5 stone was applied on a crowned base. This treatment was expected to reduce capillary action and to provide subgrade drainage. A 22-ft. reinforced concrete slab was laid over this and shoulders were graded out to 11 feet.

(Continued on Page 78)



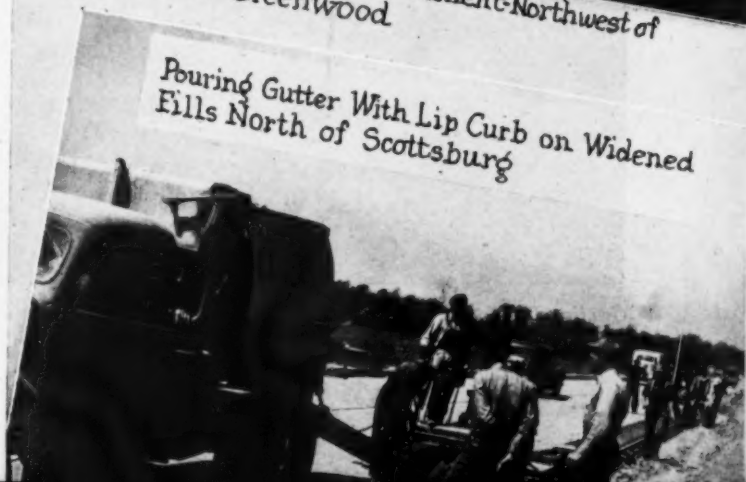
Widening Fill Across Muscatatuck Bottoms - Old Pavement Being Used to Widen Fill



Placing Reinforcing on Section Between Greenwood and Indianapolis



Broom Finishing Dual-Lane Pavement Northwest of Greenwood



Pouring Gutter With Lip Curb on Widened Fills North of Scottsburg

ROAD NOW BEING COMPLETED ACROSS ISTHMUS OF PANAMA

Latest Modern Road Building Equipment And Practices Employed

COMPLETION of a modern highway $24\frac{1}{2}$ miles across the hills and through jungles of the Isthmus of Panama, from a point near the Fort Randolph Road in the Canal Zone to Madden Dam, is expected by next spring. Built for safe use at speeds of 60 miles per hour, the highway and its bridges will safely carry a 55 ton tank.

This section of highway is a section of the 50 mile Trans-Isthmian Highway, which will connect Colon, on the Atlantic end of the Panama Canal with Panama City, on the Pacific end. Most of the highway that could practicably be located within the Canal Zone, has been built. Now the United States is constructing the remaining $24\frac{1}{2}$ miles, most of which is located within the Republic of Panama. All of the highway is on the South American side of the Canal.

Location of the entire Trans-Isthmian Highway with respect to the Panama Canal, the railroad, and the principal cities and rivers in the Canal Zone and in Panama is shown by Figure 1. This road has been increasingly in demand since the opening of the canal in 1914. Under an agreement with the Republic of Panama a U. S. Government unit, the Public Roads Administration of the Federal Works Agency, is in charge of the construction now in progress.

The completed highway will serve about 150,000 people in the Canal Zone and will connect at the City of Panama with the proposed Inter-American Highway from the United States to South America. Between Texas and the Canal, this highway now consists of about 727 miles of cart and foot trails, and 2,525 miles of roads that are either paved all-weather, or dry weather. The last 164 miles to the Canal are paved. Except for about 25 miles of all-weather road below the City of Panama, the proposed continuation of the Pan-American Highway to Colombia is still impassable jungle.

Present plans for building the Trans-Isthmian Highway are the result of a treaty with Panama proclaimed



Pouring Concrete for Culvert in Deep Sharp Gully. Not: Aggregates Are Chuted Down to Mixer Placed Part Way Down Slope. Concrete Then Chuted to Place. Labor Camp Shown in Upper Left

in 1939. Under the terms of this treaty, the United States agreed to provide a corridor from the Panamanian city of Colon, formerly entirely surrounded by the Canal Zone, to the boundary of the Zone, and to construct a highway through this corridor. The Republic of Panama, in return, agreed to provide a right-of-way to Alhajuela where the dam forming Madden Lake holds back the Chagres River and connects with the road from Alhajuela to Summit and the Pacific end of the Canal.

Design Features

The road will have two 10-foot lanes of reinforced concrete, of 9-inch uniform thickness, separated by a 4-foot bituminous strip. Eight-foot shoulders will be built on each side, making a roadway width of 40 feet, as shown in Figure 2.

The minimum radius of curvature is 573 feet, and the minimum sight distance is 600 feet. The maximum plus grade toward the Pacific will be 5 per cent. But toward the Atlantic the maximum plus grade will be 7 per cent for grades not more than 400 feet long, and 6 per cent for longer grades. The total excavation on the road is estimated to be a little more than 3,000,000 cubic yards.

Most of the excavation is expected to be of the "common" classification, although considerable ledge rock has been uncovered on the Madden Dam end, and more is expected in the deeper cuts. Some of the heavier cuts and fills approximate 100 feet in depth.

Soils.—Exhaustive soil tests are being made by Public Roads Administration soils engineers assigned to the work. Their tests will reveal the composition and classification of materials, the maximum permissible heights of fills and the safe angle of slope for cuts and fills.



Grading Operations on a Section of the Trans-Isthmian Highway Near Rio Lopez

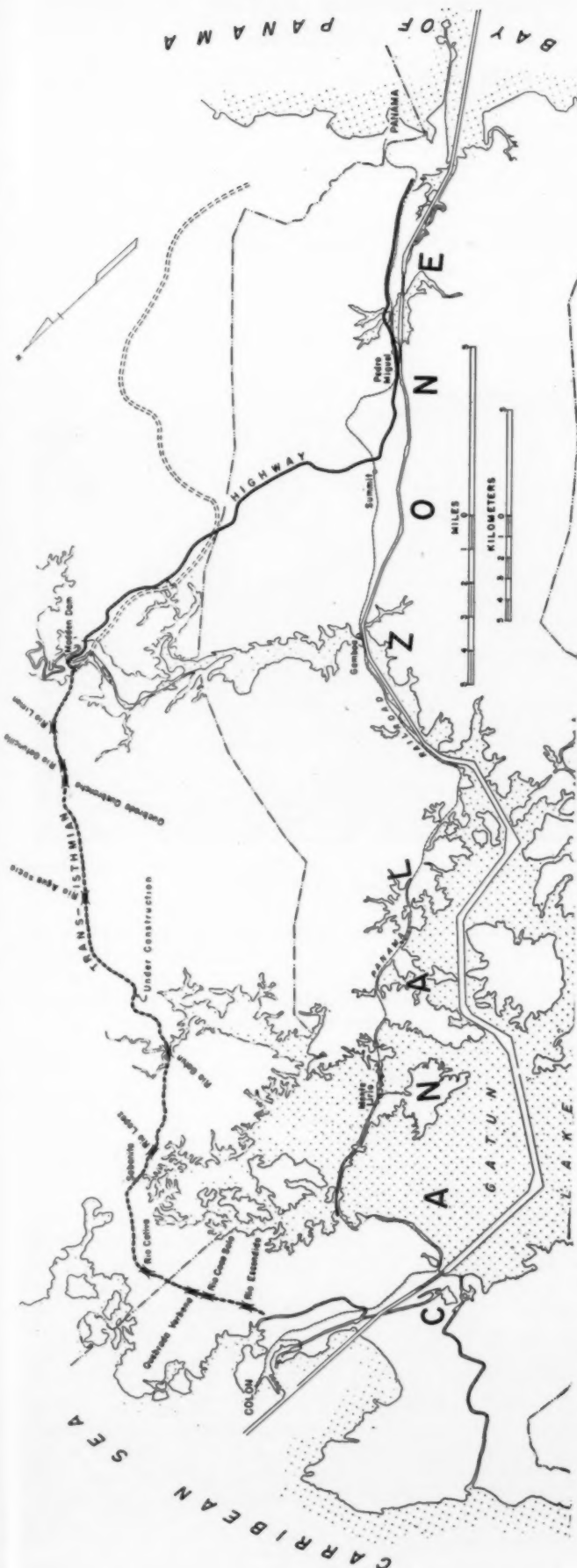


Fig. 1.—Location Line of Trans-Isthmian Highway at Panama. Most of Route Lies Outside of Panama Canal Zone

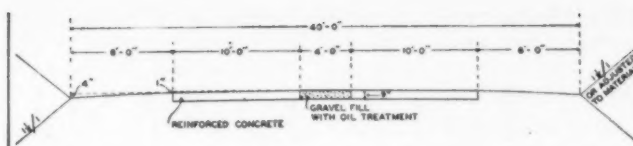


Fig. 2.—Cross-Section Adopted for Building Trans-Isthmian Highway at Panama

Bridges.—More drainage structures are required on this route than are needed on most roads of equal length in the United States, because of heavier rainfall. The average annual rainfall in Panama is about 100 inches, most of which falls from May to December, the rainy season.

Six major bridges, six minor bridges, and numerous culverts are required. The largest bridge, that over the Rio Gatun, will be 330 feet long. Each of the major structures will have three spans, with continuous steel girders. The decks will be of reinforced concrete, with a roadway width of 26 feet between curbs. Railings will be of structural steel.

In designing the bridges it was desired to avoid any sort of portal structure and to select a type of structure that could be erected regardless of weather conditions. These requirements were met by a deck structure that could be erected without falsework.

The American Association of State Highway Officials standard H-15, S-12 loading is used throughout in the design of bridges and culverts. Structures designed for this loading are capable of safely carrying 55-ton tanks.

Construction

The location survey was started from three points in October, 1940, and was completed last April. Construction of concrete box culverts is being carried on directly in advance of excavation work, and clearing and grubbing work is proceeding from various points on the projected line.

At the present time grading operations are in progress out from Madden Dam, from Rio Lopez southeastward to Rio Gatun, and in both directions from Rio Gatun near the site of the bridge crossing.

At the present time nearly a thousand men are employed on the engineering and construction of the highway. They are housed in camps located at Sabanita, Rio Gatun, and Madden Dam. Electric lights have been installed so that some of the work is on a 24-hour basis, six days a week. Twenty-seven 12-yard tractor-scraper units, three 1½-yard power shovels, and two ¾-yard draglines are in use. In addition to the tractor-scraper



Cement Unloading and Storage Shed at Monte Lirio. Cement Is Hauled Here on Panama Railroad, Shipped by Barge 11 Miles Up Gatun Lake Into Rio Gatun for Use on the Trans-Isthmian Highway

units, 15 bulldozers are used for pioneer construction and opening large cuts. A portion of the excavation is of such a nature that movement of earth by bulldozers is very economical.

All clearing and grubbing is done by native machete men and four treedozerers assist in removing from the right-of-way large trees that have been felled by the machete men.

Materials and Labor

Two eight-inch sand and gravel pumps mounted on barges are at work in Rio Gatun approximately one mile from where the route crosses the river. Sand and gravel is pumped 600 feet to a plant where it is loaded into six-yard trucks which haul the aggregates over a pioneer road to the batching plant at the crossing of the Rio Gatun.

Most of the heavy duty equipment—shovels, tractors, and scrapers—were unloaded at Monte Lirio on the Panama Railroad and carried by barge 11 miles to the point where the highway crosses the Gatun River. At other points where camps were established, pioneer roads were constructed and equipment, supplies, and materials were sledged in, using tractors.

Panamanian labor is used extensively for the unskilled labor in clearing and grubbing and other construction operations. Panamanian instrument men, chainmen, rodmen, and machete men are employed with the engineering parties.

Operators for the heavy power equipment have been brought from the United States because of the need for men skilled in the use of these types of equipment. Panamanian laborers are given every opportunity for employment in all positions for which they may be qualified.

Cement will be shipped in a chartered bottom in order to assure a constant supply. It will be brought to the work through Summit and Monte Lirio by truck and barge, respectively. Cement and structural and reinforcing steel will be shipped from the United States. Construction of reinforced concrete pavement will begin in the near future.

All engineering and construction work is being carried on by the Public Roads Administration under an agreement with Panama. Panama furnishes all rights-of-way and deposits of local materials.

GUIDE TO HISTORIC MARKERS

Minnesota has recognized the value of tourist travel to the state by the erection of over 100 historic markers by the state highway department cooperating with the Minnesota Historical Society. Going a step farther, a guide to historic markers has been compiled and printed by the Minnesota Historical Records Survey Project, Division of Professional and Service Projects, Works Projects Administration. To quote from the preface: "For convenience in reference to this volume, the state has been divided into six areas and the markers classified and numbered under those headings. Within the area the markers are listed by highways as they would be seen when traveling east to west or south to north on the roads. A map showing the boundaries of the six areas and the locations is inserted in this publication and indexes to the text will be found in the back of the book."

Copies of this guide may be secured on request through Dr. Arthur J. Larsen, Sup't., Minnesota Historical Society, St. Paul, Minnesota.

STRENGTHENING BRIDGE BY ARC WELDING

In order to accommodate the heavy truck traffic between Newark, N. J., and New York it was necessary to strengthen the floor system of the Doremus Ave. bridge in Newark. This bridge is 1,253 ft. long and was constructed in 1918 of 18 spans of second-hand railroad girders.

To make the bridge strong enough for H-20 loading, the stringers were reinforced by welding half an I-beam to the top flange of the old steel. Continuous welding was not necessary to develop the strength of the new steel so economy of material was effected by flame-cutting the beams. These were held by clamps until



Arc Welders Strengthening the Floor System of the Doremus Ave. Bridge in Newark, N. J.

welded. The old stringers were not all the same size, spacing or elevation so the new material was designed to correct this condition. It was set normally to the floor grid which was subsequently set on it, and which had a transverse camber for roadway drainage.

The floor beams were strengthened by top and bottom cover plates, so designed that nearly all the welding was flat. The only overhead welds were at the ends of the bottom cover plates. The floor grid was then placed and welded to the stringers. Curbs and walks were added and the roadway and sidewalk grids filled flush with concrete.

The work was done under contract by P. T. Cox Construction Co. of New York City, under supervision of L. M. Leedom, Section Construction Engineer of the City of Newark. William D. MacLean was superintendent. The welding was sub-contracted to J-K Welding Co. of Long Island City, New York. Total contract was about \$125,000 which included other strengthening details.

At one time there were 20 welders working on the bridge. They were all carefully qualified and the work was closely supervised. There was about 25,000 lin. ft. of field welding done by the shielded arc process with equipment supplied by The Lincoln Electric Co., Cleveland, O.

Production of High-Early-Strength Portland Cement in the U. S. in 1940 totaled 4,471,297 barrels. Shipments from the mills totaled 4,401,274 barrels.

CONCLUSIONS OF HIGHWAY MAINTENANCE STUDY IN ALABAMA

Public Relations Important Aspect of Work

By CHRIS J. SHERLOCK

Alabama State Highway Director

OBSERVATION and experience over a period of years has crystallized the respective judgments of veteran Alabama engineers in the unanimous conclusion that the general public is more interested in the State Highway Department because of its maintenance than because of its construction. The Alabama public is not concerned particularly what a highway costs, but is insistent that the highway department give them a perpetually smooth surface to ride on. Even the element of safety is subordinated to this attitude.

The maintenance activities of this Department and constant vigilance on the part of those in charge in making certain that these activities do not lag constitute, therefore, a function that is of vital importance in creating and retaining public good will and sympathetic cooperation.

The maintenance division, its officials, and those working under them, represent the contact men in the fields, between the highway department and the public. All are constantly reminded of this fact and of the consequent obligation and responsibility with which they are entrusted. They are instructed that the prestige of the Department must not be permitted to suffer through any act of theirs; that they are there to serve the public and that this service must be cheerfully, courteously and promptly rendered.

Maintenance Division Responsibilities

The burden of this obligation and responsibility rests most heavily, of course, on some thirty resident engineers and their business and social contacts with the people of the community or locality in which the job is situated that they have charge of. This being true, it is hardly necessary to comment that these resident engineers were selected with the greatest care.

With the improvement of public relations contacts



Crushed Rock Widening Is Rolled by Special Truck Wheel Roller

through the appointment and work of these resident engineers has come also a revolutionary advancement in the efficiency of maintenance operations along all lines. The placing of engineers in charge of these operations as a fixed policy was inaugurated at the beginning of the present administration. The resident engineer visits and inspects most of the roads in his territory once a day and all of them at least three or four times each week. His inspections cover both maintenance and construction operations.

This close supervision has disclosed the need for and resulted in the practical application of many improvements and a substantial saving of highway department funds.

For purposes of efficiency and economy in both construction and maintenance operations the highway department has divided the 67 counties of the state into seven separate divisions, with a division engineer and 2 assistants, appointed by the highway director, in charge of each. Every division has its own headquarters and staff. Two of these headquarters offices are located in the highway department building in Montgomery. The other five are spotted at strategic points elsewhere over the state, and are quartered in modern two-story brick office buildings constructed and maintained by the department. Each division engineer is responsible to the highway director for all construction and maintenance work in the counties comprising his division.



Widening Machine Used to Cut Trench Along Edge of Old Pavement. Base Course Rock Then Filled Into Trench. This Work Is Preparatory to Resurfacing Entire Width



Daylight View Showing Manner of Marking Highway Intersections with Luminous Signs

Residencies.—The seven divisions are subdivided into residencies, each one comprising approximately two counties, with a resident engineer and a staff of assistants in charge of each. These resident engineers handle all construction and maintenance in their respective residencies. They are appointed by the division engineer with the approval of the State Highway Director. Any construction in progress in a residency is placed in charge of a project engineer who with his staff is assigned to it by the resident engineer and must keep the work under his constant supervision until it is completed. The project engineer works directly under the resident engineer in charge of the residency, who visits and inspects the project at least once a day.

Convict Labor.—Except for skilled labor employed all maintenance work is done by state convicts. These convicts, normally totaling some 1,650 men, are quartered in 32 separate camps scattered throughout the state, and are transported to work and back again by motor trucks, daily except Sundays and holidays. The highway department builds, equips and maintains the camps, guards the prisoners and employs foremen and others who supervise their work. The State Department of Corrections and Institutions which has charge of all state prison affairs, feeds and clothes the convicts and looks after their health. For the labor of the convicts the highway department each month pays the Department of Corrections and Institutions a stipulated sum per convict per day.

Equipment.—All equipment owned by the department is pooled, and when needed for either construction or maintenance, is supplied on a rental basis by the Bureau of Equipment. In this way the department is able to keep constant track of maintenance and construction equipment costs and provide for equipment replacements as the need arises, without delay. Total maintenance and construction cost items are broken and charged to the various phases of maintenance and con-



Nightlight View Showing Same Sign as Above from About the Same Position

struction operations to which they contribute. With this detailed knowledge always at hand it is an easy matter to keep every cost item within budget limitations.

Both heavy and light equipment are used in maintenance work. Heavy equipment such as power driven machines of various kinds is obtained from the department pool on the rental basis referred to. Light equipment—picks and shovels, for example, used in routine work is permanently assigned to department divisions, and remains with the divisions' forces. Division officers must keep and make a strict account, however, for all equipment of this kind.

Cost Allocation.—Generally speaking, maintenance is divided into sections, each one calling for a different type of work according to the kind of construction that is to be maintained or repaired. For example, routine duties comprise the keeping clear of drainage structures and the maintaining of highway shoulders, both being continuous operations. The process of roadside betterment is also a continuous operation, consisting of widening of shoulders, lengthening and flattening of slopes, providing shallower ditches or eliminating them alto-



Detachable Cylinder Is Slipped Over Deflated Tires of Heavy Duty Truck then Tires Reinflated to Hold Cylinder in Place

gether, constructing ditch-checks, sodding shoulders and slopes, widening bridges and lengthening culverts. This operation not only eliminates erosion but makes the roadway safer and cuts down future maintenance costs.

Last year the state highway system had under maintenance 3,849.48 miles of bituminous surface roads, 963.87 miles of cement concrete roads, and 1,505.20 miles of gravel and earth roads, or a total of 6,318 miles of all types.

Materials and supplies going into maintenance operations are charged to the maintenance division of the work of the department, the various items being properly allocated so as to provide a correct picture of maintenance costs of every character at all times, so that they can be readily and quickly checked.

Rating.—On completion of a thorough survey of the maintenance job done, inspectors of the U. S. Public Roads Administration gave the department the highest ratings in its history, ranging up to 97 percent of a possible 100. Ratings of 100 per cent were not infrequent on the maintenance of bridges. While these ratings applied to maintenance on federal aid highways only they were representative of the entire system, as the same thorough maintenance work schedule was carried out also on state highways. The state highway system in Alabama includes 6,500 miles of roads. Of this total 4,801 miles are on the regular federal aid system.

Highway Marking.—Of particular importance to the general public, is the maintenance division's work

in marking highways. Besides the placing of the conventional markers designating, by number, U. S. and state routes, the maintenance division also establishes and maintains roadside traffic signs and directional signs. Within the past two years the marking system has been completely revised. Prior to this revision a thorough study was made of modern methods employed in a number of the more progressive states, and the best features of all of them combined in the Alabama system now in effect.

For the old style diamond shaped marker for state routes with its color combination of black on yellow, there has been substituted a white marker with the map of the state outlined on it in black. The black on yellow scheme is now used only for traffic signs. Directional signs are in black on white with broad arrows pointing the direction to cities or towns indicated, and figures showing distances. Not only are all highway intersections plainly and completely marked with directional and mileage information, but at the proper distance from each intersection, warning signs are installed giving notice that an intersection is about to be encountered. These signs perform the double duty of promoting safety and serving as a convenience to drivers.

Administrative Organization

As in construction and all other phases of the work of the highway department, maintenance operations are carried out in strict accordance with department rules and regulations and the administration of its affairs by the highway director and the members of his cabinet. The members of this cabinet composed of six experts in their respective lines, are all appointed by the director with the approval of the Governor. Each is a "career man", chosen on the basis of merit only, and without regard to political prominence or preferment. Every one of them began at the bottom of the ladder and made his way up solely through merit and its recognition and regard by successive promotions.

These cabinet members, the division of the department which they head, with a summary of the duties devolving upon each, follow:

William Herzberg, Construction Engineer, in charge of all construction operations, both road and bridge; materials and materials production, and the testing laboratories.

W. G. Pruett, Office Engineer has charge of planning surveys, budgeting of highway activities, federal aid relations, proposals, and blue printing of plans.

Marvin Taylor, Maintenance Engineer, is in charge of all maintenance operations throughout the state, also the state's traffic service.

H. B. Quinn, Superintendent of Equipment, has direct charge of and is responsible for the upkeep, replacement and distribution of all highway department equipment.

Sam W. Harbin, heads the Division of Surveys and Plans. He is responsible for all surveys and plans and the obtaining of rights-of-way.

A. D. Trum, Chief Auditor of the Department, is in charge of all department fiscal matters.

This set-up, under which the Highway Director delegates to his cabinet members details of procedure and, being relieved of this detail, is able to exercise a constant and efficient supervision over the department's activities in all its phases, has proven its practical value and workability. In the first year of the operation of this system, following reorganization of the department by the director, the highway department was able to reduce its expenses of operation by more than \$1,000,000, a result it has since consistently maintained.

Soil Stabilization

Summary of Papers Presented at Twentieth Annual Meeting, Highway Research Board, Washington, D. C., Dec. 4, 1940

By HAROLD ALLEN

Public Roads Administration

BASE courses for light type surfaces in which soil is one of the major constituents may be divided into the following groups: (1) Soil-aggregate mixtures, (2) Soil-cement mixtures, and (3) Soil-bituminous mixtures.

The soil-aggregate type consists of a mixture of aggregate particles and soil fines. The stability of the mixture depends, primarily, upon the grading of the aggregates and the characteristics of the soil binder. Research and field experience have established the fact that the quantity of soil fines and their plastic characteristics as measured by the liquid limit and plasticity index are the controlling factors in the design of mixtures suitable for use in base course construction.

PI-LL Relationships.—A paper presented by Mr. Deklotz of the Public Roads Administration described a research project made in cooperation with the Engineering School of Oregon State College in which the relation of the plastic properties and quantity of soil fines and the bearing power of soil-aggregate mixtures were investigated. [This research investigation was written up in an article by Mr. Deklotz for *ROADS AND STREETS* and was published in the March, 1941, issue, page 40.—Editor.]

In the investigation a gravel of constant and uniform gradation, passing the 1-inch sieve and retained on the No. 40, was mixed with each of three soils having liquid limits of 25, 33, and 44, and PIs of 4, 14, and 21 in percentages of 13, 23, and 33. A quantity of water equal to the optimum moisture for each of the gravel-soil mixtures was added and samples were molded in a mold of the type used by the California Division of Highways in the determination of the bearing power of soils. The loads required to force a piston having a bearing area of 3 sq. in. into the sample at a ratio of 0.05 in. per min. was measured and recorded for each 0.1 in. of penetration. The results obtained were compared with values obtained with a sample composed of crushed stone of standard grading and density.

The writer draws the following conclusion after a careful analysis of the data obtained: "As a result of this series of tests, it was found that there appears to be a definite relationship between the plasticity index and liquid limit and stability which should be of considerable value in the design of subgrades, base, and surface courses. Those tests also suggest that the practice of rejecting aggregates on the basis of liquid limit and plasticity index tests without providing for consideration of the relative importance of the quantity of soil in the aggregate tested may often be uneconomical. That is, local materials which upon further investigation would prove to be satisfactory or which could be readily modified may be passed over in favor of more expensive materials."

Surface Consolidation.—Mr. Elleman's paper described the construction and maintenance methods necessary to obtain a surface consolidated road. Under construction he included the operations required when: (a)

roads lack binder, (b) roads lack aggregate, (c) roads lack moisture, (d) new roads and (e) drainage and crown. Under maintenance he describes: (a) Spring, Summer and Fall maintenance, (b) hand patching and (c) treatment with calcium chloride. The author lists the following advantages for this type of surface consolidation: (1) A variety of local surfacing materials which are available in most regions can be utilized, (2) Special technical knowledge is not required in the selection of these materials; selection being based on the individual roadman's experience, (3) The cost is low, and (4) This road type fits well into a stage construction program.

Soil-Cement.—The project committee on the use of portland cement in the stabilization of soils has circulated to all of the states in the United States a questionnaire designed to obtain information on the construction, maintenance, and service of the roads built in which soil-cement mixtures were used as a base course. Forty-six questionnaires have been returned. Twenty-three of the states reporting have no mileage of this type and the remaining twenty-three have given the committee detailed information on approximately 200 mi. of road. These data have not been thoroughly analyzed by the committee, but a general examination disclosed that this type is giving good service on most of the projects built to date and that research is necessary to solve some specific problems incident to the improvement of the type. These immediate problems may be listed as follows: (1) Thickness of bituminous wearing surface; (2) Final construction operations on finishing the top of the base course; (3) Mixing operations; (4) Laboratory procedures; and (5) Study of cement contents.

It has been observed that the use of a very light bituminous surface treatment on a soil-cement base course often results in surface failures which consist of the breaking of the bituminous-coating and subsequent peeling of the mat. This has not been observed when the quantity of aggregate used in the bituminous covering exceeds 75 lb. per sq. yd.

The failure of the thin surface may be due in some cases to the presence on the top of the base of a layer of soil-cement mixture, varying in thickness from $\frac{1}{8}$ to $\frac{1}{2}$ in., which does not set up. Studies of the final operations in the finishing of the base are being made in several localities in an attempt to correct this condition.

An examination of some soil-cement projects disclosed loose unconsolidated materials next to the subgrade and varying in thickness from $\frac{1}{2}$ in. to 1 inch. There is evidence that this condition may be overcome by changes in equipment used in mixing the water, soil, and cement.

The laboratory procedures which are in use for the testing of soil-cement mixtures and for the determination of the proper cement contents are not entirely satisfactory from the standpoint of efficient use in the average highway laboratory due to the length of time involved in the completion of the tests. The average time required to determine the cement content necessary to stabilize a given soil is about 60 days. The results obtained by the methods are also influenced somewhat by the personal equation because some of the operations are based upon the judgment of the operator. Many states are studying different methods of test and it is the intention of the project committee to make a canvass of the states in an effort to collect data on the methods which show promise and make them available for the use of all those interested in the problem.

Several experimental projects have been built in

which the cement contents have been varied from those indicated by the standard methods of design. Cement contents as low as 3 per cent and as high as 11 per cent varying by 2 per cent increments were used on one project. After 3 years the sections containing 3 per cent cement were in good condition but showed signs of distress while the 5, 7, 9 and 11 per cent sections were in good condition and showed no evidence of weakness. It should be kept in mind that the soil, the cement, and the climatic condition will be different for each project and that these results should not be interpreted too literally.

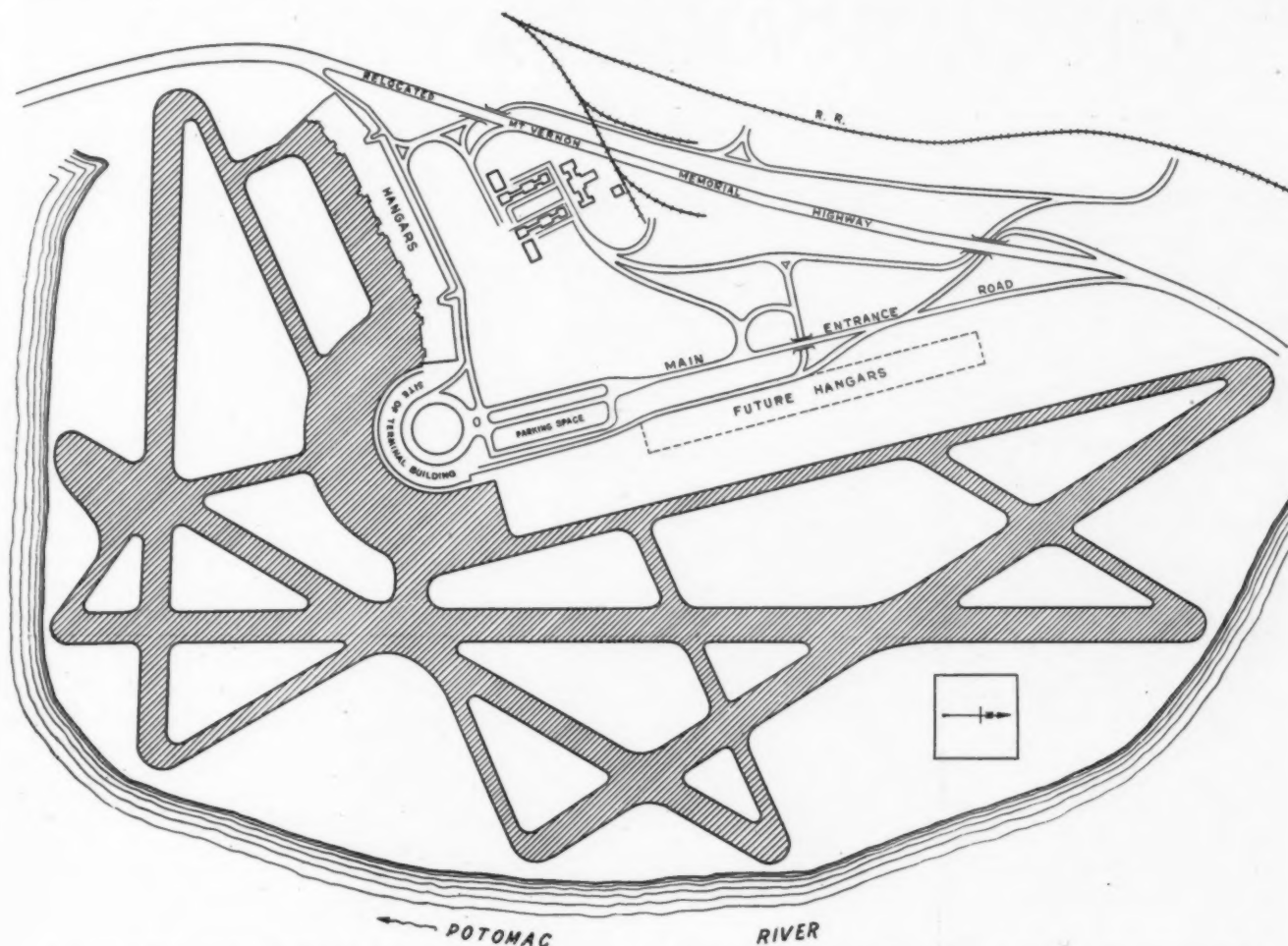
As a control measure during construction chemical analyses have been used successfully by several states as a check on the uniformity of distribution and the quantity of cement. The procedures consist essentially of finding the CaO content of raw soil, cement, and soil-cement mixtures and using the result in the calculation of the cement content. The methods have been used in 8 states and the results obtained are reported to be satisfactory. The project committee will make further investigations of the procedures during the coming year.

A statistical study of the relation of cement content and the various soil characteristics of 329 soils from 37 states was reported by Mr. Miles D. Catton of the Portland Cement Association. These studies also included an examination of compressive strength data of soil-cement mixtures. The author offers the following conclusions: (1) The strength data are of major value in determining whether the cement is reacting with the soil in a normal manner since normal reaction is shown by increases in compressive strengths with increases in age and increases in cement content. In general, compressive strengths tend to increase with increases in the densities and decreases in the optimum moisture of the soil-cement mixture. (2) The combined data show that the Public Roads Soil Classification is the best general index of cement requirements for satisfactory results and give definite proof that, with information now available, the only dependable method for the determination of cement requirements is by the wetting-drying and freezing-thawing tests.

Soil-Emulsion Mixtures.—In a paper on the recent developments in the design and construction of soil-emulsion road mixtures, Mr. C. L. McKesson described improvements which have been developed recently in this type of soil stabilization. Special emphasis is placed on the drying of the finished soil-emulsion mixture after it is placed on the subgrade. The author draws the following conclusion: "Laboratory tests and field data indicate that very much more rapid and more thorough drying can be obtained by the construction of a stabilized base in layers approximately 2 in. in thickness, and by allowing each layer to dry before the subsequent layers are placed. It would appear that drying time increases approximately in proportion to the square of the thickness of the layers used and that three 2-in. thick layers can be dried in about one-third the time required for a single 6-in. thickness.

Active Admixtures.—Mr. Winterkorn presented in his paper both the theoretical and practical aspects of physico-chemical testing of soils. His theoretical concept indicated the directions in which soil properties can be changed by physico-chemically active admixtures such as soluble salts, bituminous materials and portland cement. The author expressed the belief that surface chemistry and especially the concept of linkage as an electrostatic phenomenon will be a great aid in solving many of the outstanding problems in the future development of soil mechanics and stabilization.

THE WASHINGTON NATIONAL AIRPORT



Layout of Washington National Airport Showing Runways, Taxiways, Roads, Railroads, Buildings and the Potomac River

GENERAL NOTES

Airport is located 2 miles south of Washington Monument.

Hot-laid asphaltic concrete calls for 5 to 7 per cent asphaltic cement of $120/150$ penetration in base and 6 to 9 per cent in surface; maximum mixing temp. 325°F . Mixtures contain uncrushed aggregates except 15 per cent in surface course.

Locally available sand-gravel used throughout at bid price of \$2.11 per ton for processing, sizing and crushing gravel, also furnishing asphalt, mixing, placing and compacting asphaltic concrete.

Runway	Length	Width
N-S	6875'	200' paved; 150' gravel shoulders each side
E-W	4200'	150' paved; 175' gravel shoulders each side
NW-NE	5300'	200' paved; 150' gravel shoulders each side
NE-SW	4882'	150' paved; 175' gravel shoulders each side

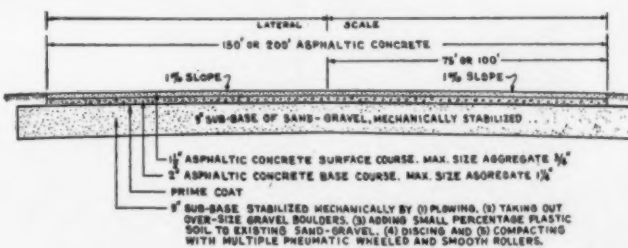
Compacted asphalt mixtures estimated to weigh 110 pounds per inch of depth, per sq. yd.

Production of asphalt mixtures estimated at rate of 1,000 tons per working day.

Mechanically stabilized sub-base constructed with government forces, and estimated to cost 30c per sq. yd. including prime coat and fine grading.

Fine grading not being a portion of cost of pavement and sub-base, the over-all cost of the sub-base, base and surface is, therefore, somewhat less than 70 cents per square yard.

Surfacing on this important commercial airport was designed by officers in the Army's Corps of Engineers; engineers from Civil Aeronautics Authority, WPA, Public Roads Administration, WPA and Public Buildings Administration also collaborated.



Cross-Section of Runways and Taxiways Showing Types of Construction

NEW CONSTRUCTION FEATURES ON CALIFORNIA PAVING JOB

High Pouring Schedule Maintained With Modern Equipment



ON THE paving project between San Jose and Gilroy, California, N. M. Ball Sons Co. made excellent progress through the intelligent use of their equipment. Briefly the work consisted of laying 2 lanes of concrete slab 11 ft. and 12 ft. wide adjacent to the existing 2-lane highway with the wider pavement adjoining the center for use as a passing lane. The project is 5.65 miles long and will cost \$181,632.00. Some of the principal items were 15,000 cu. yds. common excavation, 25,000 cu. yds. borrow for sub base, 15,700 sq. yds. P.C.C. surface, and 3,200 cu. yds. plant mix for shoulders and division strip.

The borrow material was a creek gravel secured 4.5 miles from the job. This was spread in a 9-in. layer, then thoroughly compacted and the forms set. A Standard-Lewis subgrader was used to fine grade. By this time the batching plant was erected. The method of handling materials is unusual.

A Northwest dragline equipped with a 1½ yard Page bucket with preformed wire rope on the hoist lines and on the haul-back handled the aggregate to the hopper. The dragline bucket replaced a clamshell with excellent results. This setup is shown in pictures 3 and 4. Note how the dragline stands on a built-up ramp around which the 4 sizes of aggregates



are stock-piled in bunkers. The cement is delivered in bulk by truck and trailer and an A-frame hoist is used to dump the trailer. The truck first is uncoupled and dumped. It then pushes the trailer into position under the A-frame as shown in picture 2. The cement is elevated to a storage bin and deliv-



ered to the Conveyco batch plant by screw conveyor as shown in picture 4. Picture 1 shows an International 2-batch truck under the hopper. The paving operations are shown in pictures 5, 6, 7, 8. The Koehring 27-E paver works from the side. The man in the foreground of picture 5 is placing one of the full redwood expansion joints which are placed on 120-foot centers. Picture 6 shows the Jaeger-Lake-wood finisher with vibrating screeds. No. 7 shows the Johnson float finisher which applies the finish in 6 or 7 passes. Cotton mats are used for curing for a 72-hour period. The mats are kept



wet by the sprinkling equipment shown in picture 8.

A piece of equipment not shown in the pictures is a device used to remove the forms. It is a long handled lever mounted on two wheels and equipped with hooks which grab the edge of the form. This home made unit breaks the forms out easily.



OBSERVATIONS BY THE WAY

By
A. PUDDLE JUMPER



¶ As I came through Kentucky I noticed, along U. S. 41, that cheese cloth strips were pegged down on many backslopes of highway cuts. It was early spring and no grass had yet appeared through the cheese cloth. I assumed that this plan was not very successful so I never took a picture of it. It was south of Bowling Green. Next day I was talking with Tom Cutler and mentioned these strips. He said they were quite successful. After that I saw no more of them to photograph so cannot give you an illustration.

¶ The former governor's policy in Georgia was certainly as unsound as that attributed to the present governor, but one good thing resulted, viz., smooth, super-elevated, blacktop surfaced curves on many roads.

¶ From where does all this hospitality in Alabama's highway operations emanate? My highest compliments to Chris Sherlock and his staff, as well as a good word for the highway patrol. Hospitality seemed to me to be a watchword over the entire state (and I covered a lot of it this spring).

¶ Alabama must also be complimented on their bridge hub rails and hand rails, except those on U. S. 3 and 90 east of the east end of Bankhead Tunnel at Mobile. Chris, remove the top handrail so folks in motor cars can see what's on the water and in the fields to the sides. Incidentally, it seems to me that this stretch of road should be 4-lanes even though the tunnel is only two lanes. Sunday traffic jams.

¶ WISECRACK.—Hard times is when hitch hikers are willing to go either way.

¶ Herewith picture of a traffic aid just north of El Dorado, Kansas, at



the junction of U. S. 77 and State Route 13. It's different.

¶ By the way, for variability of types of wooden culverts and for maintenance of an extremely dangerous underpass and bridge crossing, that Kansas State Route 13 "takes the cake." That bridge just north of the underpass must have been put there by Kit Carson or Calamity Jane.

¶ First experimental length of stone striping placed in Texas. It is reported that it was put down in 1936 by J. W. Volletine on U. S. 90 just



east of Waelder. The stripe was about 50 ft. long.

¶ Many of our readers who remember the Gratiot Avenue (Detroit) of the old days will probably be amazed to notice the marvelous job that has been done in widening this street. Fact is, Detroit deserves a lot of



credit for the splendid job they have done in widening Woodward, Gratiot, and Michigan, three of the major arteries of this city. It might be mentioned in passing, while this particular picture was taken only a mile or so east of the downtown section, Gratiot has been widened away out for several more miles, and has become a real arterial instead of just another street.—Contributed to Bert Brumm.

¶ "----- But Only God Can Make a Tree." Innocent victims of modern



highway progress in scene on U. S. 20 west of Norwalk—widening project.—Contributed by Bert Brumm.

¶ The traffic situation in Detroit is slowly improving. On a recent trip to the Motor City we saw only five accidents in two days.

¶ The sign shown herewith is self explanatory. A. G. C. contractors agreed some time ago to help the



"Contract System" by advertising their work on the job. This job is in Missouri.

¶ Hip! Hip! Another antiquated, dangerous bridge is about to "get the axe." This one is just north of Norwalk on Ohio 61. Surveying party's car in immediate foreground gives



hint of something going on—relocation project is contemplated, new road to be to the left of retaining wall.—Contributed by Bert Brumm.

¶ He was walking nonchalantly down the street one day when he was stopped by a pretty young lady. "Oh!" she said, "I beg your pardon. I thought you were the father of two of my children." And she hastened on. Flabbergasted, he started after her. How was he to know that she was a school teacher?

¶ Tennessee—Noted for its white center markings and well cared for 8-ft. shoulders on U. S. 31 south of Nashville to Spring Hill.—Contributed by Larry Lingnor.

¶ Which reminds me of a sign on the edge of Hinsdale, Ill. It is on one of Hinsdale's outside edge streets and is nailed onto a pole just under a street light so that it will do the most good when it is needed the most. It reads:

YOU ARE HEADED EAST
ON 31ST STREET ON THE
SOUTH SIDE OF
HINSDALE

That sign certainly straightened me out in a hurry.

¶ Sometime if you want to go exploring on mountain trails, drive over N. Y. State Route 17 from Lake Erie through Johnstown, Corning, Binghamton and Middletown. The trail wanders eastward across the south side of New York State. Be sure you have nothing else to do or that you are not planning on getting somewhere in a hurry, because if you do, you'll be badly surprised.

¶ By the way, the highest point on the New York state highway system is on Route 17 near the western or midwestern end. It is elevation 2316.

¶ Experience to date, after a three-year test, on a steel battledeck bridge floor test panel appears to justify the conclusion that, on highway systems where bituminous pavement surfaces are in use and maintenance is therefore a matter of course, a steel battledeck bridge floor with a thin, properly designed bituminous cover should give entire satisfaction.

¶ There is more snow on Colorado's mountains this year than for several years past. Heavy falls during April and May is the reason.

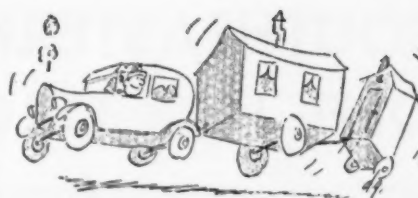
¶ MY HOME ON WHEELS By Mrs. Milo Lahn

Lend me your ears, Ye Traveling Engineers!!

To those who know what it is to be moving all year round, I would especially dedicate this article. I don't profess to be a writer, but in hopes I may help someone else to see the light, I have set forth my ideas herein.

If you will pardon me for personifying the most humble of all places, home, I want to say what an angel of peace the trailer house was when it came to our assistance.

Have you ever been perfectly content where you are living when one evening in pops hubby and says, "Well, get packed, we have to be in — (well, most any place 100 or 200 miles away or maybe farther) tomorrow." If you have, then you know how my heart would sink when I heard those words. It meant slinging things into boxes, etc., and trying to get everything packed into a car. By the time you had burned half of what you had accumulated during this stay because there wasn't room for it, and hubby would be making some of the following remarks—"For cat's sake, you don't need to take that along;—Well, there just isn't room;—No, the kids will have to find something else to play with," I'd



pack a box and ask my best friend if she would please keep this for awhile until I'd settled. A lot of folks know I haven't settled yet, or have forgotten.

This was only the beginning, however. When we would arrive at our appointed destination, tired out, we had to commence our feverish search for a place to live. No apartments to be had, especially if you have children,—children and dogs are taboo. We would finally find a place to hang out. No, I wouldn't like it and the husband thought I was too unreasonable. "I just can't find anything else, it'll have to do," he would say. So of course I'd take it, none too pleasant I must confess, but knowing it wouldn't be long until we would be gone. Those who have tried it know what is likely to follow, because everyone is tired and cross. It would stop just in time to prevent another divorce.

After moving thirteen times in three months we made up our minds that the trailer house was the solution. Now we have a lovely home on wheels. We may have been compelled to shut down on the beers, etc., until we got the papers that said it was ours, but we couldn't get along without it. Now when hubby says we have to move tomorrow, I say, "O. K., let's go, I'm ready." No packing, no harsh words to regret, no house to hunt when we get there, and above all a happy family—so essential.

If you've never tried the trailer way of living on road jobs, I'd advise a fling at it. I'm sure you'll agree it is the only way out. On the other hand if you have always lived in a trailer, don't get the idea it would be nicer to live in apartments or cabins, because a lot of the time they just aren't there.

I believe now you understand why I have called the Home on Wheels an "angel of peace."

Let me live by the side of the road,
"Tho it's not a mansion grand,
'Twill afford myself, hubby and kids
All the glorious times we've planned.
We'll work and we'll fish to our
heart's content

And while others bicker and sob,
We'll hitch our house to the old
sedan

And move to another job.

—Frow Montana Center Line.

SOUTHEASTERN HIGHWAY OFFICIALS ORGANIZE



Present at the meeting at which the Southeastern Highway Officials organized at Montgomery, Ala., July 1, 1941, were:

First row—Fred O. McManus, Secretary, Alabama State Highway Dept., Montgomery; J. S. Williamson, Chief Highway Commissioner, Columbia, S. C.; Miss Lucile Branscomb, Secretary to State Highway Director, Montgomery; W. Vance Baise, State Highway Engineer, Raleigh, N. C.; Chris J. Sherlock, State Highway Director, Montgomery.

Second row—R. A. Harris, Chief Engineer, Mississippi State Highway Dept., Jackson, Miss.; J. K. Crowson, Asst. to State Highway Engineer, Columbia, S. C.; V. J. Brown, Publishing Director, "Roads and Streets," Chicago, Ill.; W. J. Gooding, Jr., Bridge Engineer, Columbia, S. C.; W. H. Mills, Testing Engineer, Columbia, S. C.; J. J. McNamara, Asst. Highway Engineer, Jackson, Miss.

Third row—W. M. Golden, Jr., Cost Accountant, Alabama Highway Dept., Montgomery; Alex Trum, Auditor, Alabama State Highway Dept., Montgomery; Harold A. Gumpf, Fiscal Accountant, Ala. Highway Dept., Montgomery; N. S. Anderson, District Engineer, U. S. Public Roads Administration, Spartanburg, S. C.; George P. Thigpen, Testing Engineer, Alabama Highway Dept., Montgomery; A. Reese Harvey, Jr., Chief of Planning Survey, Ala. Highway Dept., Montgomery.

Fourth row—W. G. Pruett, Office Engineer, State Highway Dept., Montgomery; Chas. D. Sned, District Engineer, U. S. Public Roads Administration, Montgomery; C. W. Phillips, Commissioner of Highways and Public Works, Nashville, Tenn.; Sam W. Harbin, Engineer Surveys and Plans, Ala. Highway Dept., Montgomery; Leon Gottlieb, Bituminous Engineer, Ala. Highway Dept., Montgomery; R. P. Ellison, Equipment Engineer, Virginia Dept. of Highways, Richmond; J. W. Gentry, State Highway Engineer of Tennessee, Nashville.

Fifth row—Marvin Taylor, Maintenance Engineer, Ala. Highway Dept., Montgomery; H. B. Quinn, Supt. Equipment, Ala. Highway Dept., Montgomery; William Herzberg, Construction Engineer, Ala. Highway Dept., Montgomery; T. H. Espey, 7th Division Engineer, Ala. Highway Dept., Montgomery; T. S. Burnum, Supt. Convict operations, Ala. Highway Dept., Montgomery.

Joseph R. McCoy, Director Bureau Publicity and Information, and Curtis Frizzell, State Photographer, Montgomery, were present at the meeting but do not appear in this picture.

REPRESENTATIVES of six of the ten Southeastern States meeting Tuesday, July 1, at the Whitley Hotel, Montgomery, Ala., formed an organization to be known as Southeastern States Highway Officials, which will be affiliated with the American Association of State Highway Officials, an organization national in scope. Up to that time the southeastern states were one of the few remaining unorganized regional state groups.

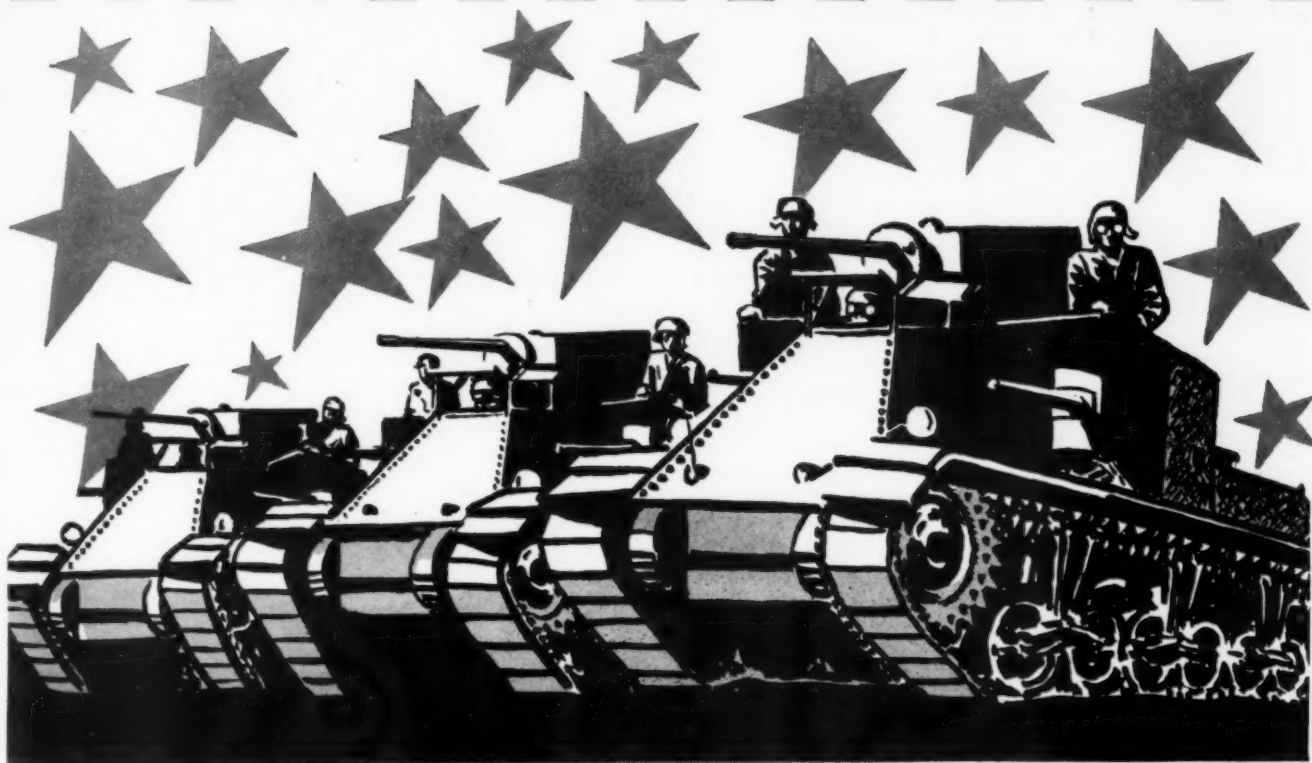
The new body is headed by W. Vance Baise, State Highway Engineer of North Carolina, with offices in Raleigh—as President. State Highway Director, Chris J. Sherlock of Alabama was chosen Vice President, and B. W. Davis, Maintenance and Equipment Engineer of

the North Carolina Highway Department, Secretary-Treasurer.

Mr. Sherlock served as temporary chairman until Mr. Baise was elected, and took charge of the meeting. Fred O. McManus, Secretary of the Alabama Highway Department, acted as temporary secretary, and Miss Lucile Branscomb, Private Secretary to the Highway Director, made a stenographic record of the proceedings.

The States represented at the meeting were Alabama, Mississippi, North Carolina, South Carolina, Virginia and Tennessee; also two U. S. Public Roads Administration Districts of the Southeastern territory. States not represented in the Southeastern group were Florida,

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Georgia, Kentucky and West Virginia. All four not represented notified the meeting of their interest in the organization and their full accord with its objectives. These States were issued cordial invitations to become members.

Immediately after the session convened Commissioner Williamson of South Carolina explained its purpose was to determine whether the Highway officials of the Southeastern States would organize as a group, pointing out that many other regional areas throughout the nation had already done so. He stated that the purpose of such an organization would be an exchange of ideas by highway officials of the respective States so that each Highway Department would obtain and benefit by the experience of the other. "No State," he said, "can live within the confines of its own boundaries. In common with the other States it must strive to acquire and apply uniformity in the handling of problems arising in connection with the facilitating of highway travel and uniformity of highway laws." Similar ideas were expressed by nearly every other member of the group.

At conclusion of discussion those present voted unanimously to create the organization which was immediately formed. A special committee was promptly appointed to decide on the name of the organization and nominate those who would be its officers. A recess was then taken for luncheon at which Alabama Highway officials were hosts. Reconvening after lunch the special committee made its report, officers were nominated and elected and it was voted that the name of the organization should be Southeastern Highway Officials.

The board of Directors, yet to be selected, will be chosen on the basis of highway officials of each State in that group, composing a State board of Directors, electing from their number a representative on the Association's Board of Directors.

HAND LABOR EFFECTIVE

"I do not intend to compare machine methods and costs with hand labor and costs, but I do want to show that on 80% of our county highway work we could stop our machinery today and take up with W.P.A. unskilled labor tomorrow where we left off without much change in details or plans. Thus highway construction and maintenance is an ideal setup for W.P.A. projects." Thus spake Mr. E. K. MacAllister, County Engineer, Jackson County Road Commission, Michigan, at the Annual Highway Conference at the University of Michigan in a discussion on W.P.A. Highway Programs and County Cooperation. County highway work could just as well be done by W.P.A. unskilled labor as by labor saving machinery so far as details or plans are concerned. This is not true everywhere, fortunately.

GEORGIA ISSUES A NEW MANUAL

The Georgia Manual of Uniform Traffic Control Devices has recently been released by the Division of Traffic and Safety, State Highway Board of Georgia, M. C. Bishop, Director; G. T. Papageorge, State Traffic Engineer; R. D. Dier, Assistant Traffic Engineer. This manual is the first authorized step toward state wide uniformity of traffic control devices, and the standards set out in the manual have been adopted by the state.

The book is characterized by its lucid explanations of procedure both in the written description and in the drawings.

GASOLINE CONSUMPTION AND RECEIPTS IN 1940

State taxes were imposed on more than 22 billion gallons of gasoline in 1940, according to reports of state agencies to the Public Roads Administration of the Federal Works Agency.

Refunds of the full amount of the tax, chiefly for nonhighway use, were made on 1,258,151,000 gal., and, in addition, partial refunds were made on approximately 28,000,000 gal. Tax exemptions increased in 1940 to 854,008,000 gal., compared with 703,604,000 gal. in 1939. Tax levies were made on 1,283,000,000 gal. more than in 1939, according to state agencies.

Table 1 shows the tax rate and net receipts for each state in 1940 and the percentage increase over the preceding year.

TABLE 1.—GASOLINE CONSUMPTION STATISTICS, 1940

State	Tax rate (Cents per gallon)	Percent increase in consumption over 1939	Net Total Receipts
Alabama	6	7.7	\$15,535,000
Arizona	5	6.4	4,769,000
Arkansas	6.5	4.3	11,412,000
California	3	5.1	51,978,000
Colorado	4	5.4	8,291,000
Connecticut	3	8.8	11,084,000
Delaware	4	7.3	2,325,000
Florida	7	11.0	27,448,000
Georgia	6	9.6	22,841,000
Idaho	5.1	6.9	4,825,000
Illinois	3	5.6	41,824,000
Indiana	4	7.1	26,068,000
Iowa	3	3.6	14,655,000
Kansas	3	3.6	10,562,000
Kentucky	5	7.3	14,717,000
Louisiana	7	6.7	18,671,000
Maine	4	5.1	5,940,000
Maryland	4	7.9	11,448,000
Massachusetts	3	10.4	21,454,000
Michigan	3	8.8	32,479,000
Minnesota	3 ¹	6.0	18,526,000
Mississippi	6	4.9	11,931,000
Missouri	2	6.0	13,455,000
Montana	5	5.6	5,074,000
Nebraska	5	0.6	11,901,000
Nevada	4	6.2	1,507,000
New Hampshire	4	2.7	3,617,000
New Jersey	3	6.3	24,337,000
New Mexico	5	9.1	4,699,000
New York	4	3.9	73,116,000
North Carolina	6	7.4	27,372,000
North Dakota	4	3.7	3,452,000
Ohio	4	7.3	50,789,000
Oklahoma	4	3.4	15,067,000
Oregon	5	7.4	11,359,000
Pennsylvania	4	6.7	62,495,000
Rhode Island	3	3.8	3,945,000
South Carolina	6	10.8	13,910,000
South Dakota	4	9.3	4,527,000
Tennessee	7	12.5	22,320,000
Texas	4	4.8	47,530,000
Utah	4	8.6	4,056,000
Vermont	4	4.2	2,781,000
Virginia	5	9.4	19,410,000
Washington	5	8.4	17,185,000
West Virginia	5	6.6	10,691,000
Wisconsin	4	4.3	21,311,000
Wyoming	4	5.1	2,774,000
District of Columbia	2	12.7	3,229,000
Total	3.96 ²	6.2	\$870,692,000

¹ Rate changed from 4 cents to 3 cents September 1.

² Weighted average rate.

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CONTROLS

PROPOSED ACCELERATED ASPHALT EMULSION TEST STUDIED

Investigation of the Downing Modified Miscibility Test

By J. ROGERS MARTIN

Junior Chemical Engineer, Texas State Highway Department

and JUDSON SWEARINGEN

Associate Professor of Chemical Engineering, University of Texas

With Discussion by C. A. DOWNING

Formerly Engineer in Charge, Municipal Testing Laboratory, St. Louis, Mo.

A N important property of emulsified asphalts is the ability of the asphalt to stay in uniform suspension, neither settling to the bottom nor rising to the top. Poorly prepared emulsions, when placed in storage for any length of time may settle to such an extent that a thick mass of asphalt is formed at the bottom, which may or may not be coagulated but cannot easily be reclaimed. In addition, the top portion in such cases is usually thin and deficient in asphalt.

TABLE I
SAMPLE IDENTIFICATION

Sample No.	Type	Source of Crude
1	For soil stabilization	West Texas
2	For soil stabilization	East Texas
3	For coarse graded aggregate	West Texas
4	For coarse graded aggregate	East Texas
5	For densely graded mixes	East Texas

TABLE II
PROPERTIES OF SAMPLES

Sample No.	1	2	3	4	5
*Viscosity, Furol at 77 degs. F.	44	46	47	51	42
*Cement Mixing Test, percent	Trace	Trace	0.2	100	0.1
*Demulsibility Test, percent	Nil	Trace	Nil	Trace	Trace
*Sieve Test, percent	Trace	Trace	Trace	0.02	Trace
*Dehydration	0.81	0.74	0.61	0.54	0.55
*Miscibility (Qualitative)	Passing	Passing	Passing	**Failing	Passing
*Residue by Evaporation, percent	58.8	60.3	62.2	62.8	64.2
*Tests on Residue:					
Ductility at 77 degs. F.	59	47	68	46	47
Penetration, 100g., 5 secs., 77 degs. F.	65	72	155	115	100
Solubility in CCl ₄ , percent	99.00	97.50	97.63	97.70	98.03
Specific Gravity at 77 degs. F.	1.025	1.033	1.023	1.031	1.026
Sp. Gr. of Original Emulsion (undiluted)	1.025	1.030	1.022	1.022	1.026
Sp. Gr. Diff., Asphalt, Liquid	.000	.009	.002	.025	.000
*5 Day Settlement	Nil	2.1	1.2	9.4	0.3
Downing Misc., Max. Diff., percent	14.7	6.3	13.6	38.9	3.4
Sp. Gr. Diff., 1:3 Dilution	.023	.030	.021	.029	.023
Visc. Poises, 77 degs., 1:3 Dilution	.0148	.0132	.0148	.0136	.0138
Avg. Particle Size, Microns	3.95	4.65	2.67	3.10	3.65

*Tests were run in accordance with A.S.T.M. D-244.

**Considerable settlement with slight coagulation.

TABLE III
SETTLEMENT DATA

Sample No.	1 percent	2 percent	3 percent	4 percent	5 percent
1 Day					
Bottom	58.78	60.80	62.80	63.56	64.44
Top	58.76	60.32	62.32	60.48	64.60
Difference	0.02	0.48	0.48	3.08	-0.16
2 Days					
Bottom	58.70	61.04	62.44	63.84	64.56
Top	58.76	60.22	61.88	59.92	64.64
Difference	0.06	0.82	0.56	3.92	-0.08
5 Days					
Bottom	58.86	61.08	62.16	63.86	64.38
Top	58.86	58.96	60.96	54.50	64.10
Difference	0.00	2.12	1.20	9.36	0.28
10 Days					
Bottom	58.88	60.60	62.04	65.96	63.86
Top	58.80	57.46	60.88	41.82	64.20
Difference	0.08	3.14	1.16	24.14	-0.34

TABLE IV
DOWNING MISCIBILITY DATA
(Average of 3 runs)

Sample No.	1 percent	2 percent	3 percent	4 percent	5 percent
Top	10.82	10.69	10.43	5.93	12.81
Middle	12.57	13.30	12.74	6.53	14.78
Bottom	25.47	17.00	23.99	44.80	16.21
Max. Diff.	14.65	6.31	13.56	38.87	3.40

The test commonly used by consumers for acceptance or rejection on this property is the A.S.T.M. Five Day Settlement Test. The test, briefly described, is as follows: A 500 ml. graduate is filled to the top mark with the material to be tested, stoppered and set aside undisturbed for five days. At the end of this time the asphalt content in the top and bottom 50 ml. portions is determined. Most specifications allow a maximum difference of 5 per cent between top and bottom.



A

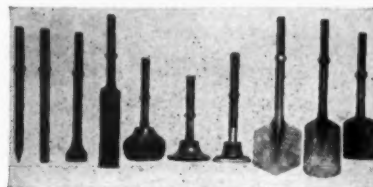
Cleveland

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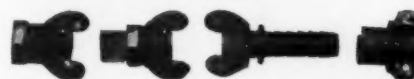
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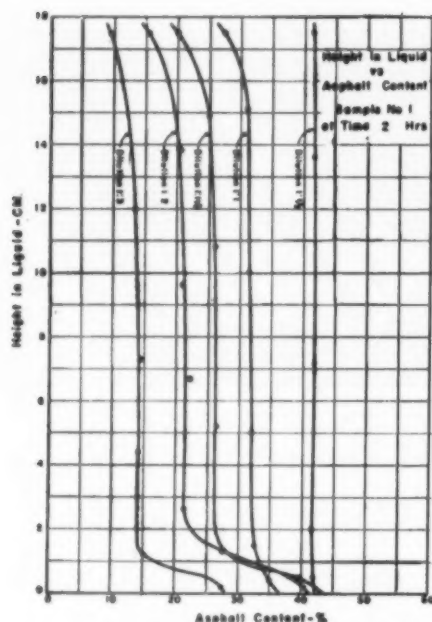


Fig. 1.—Asphalt Content at Various Heights of Sample No. 1 in Definite Height of Liquid After Two Hours Settlement. Various Dilutions Shown

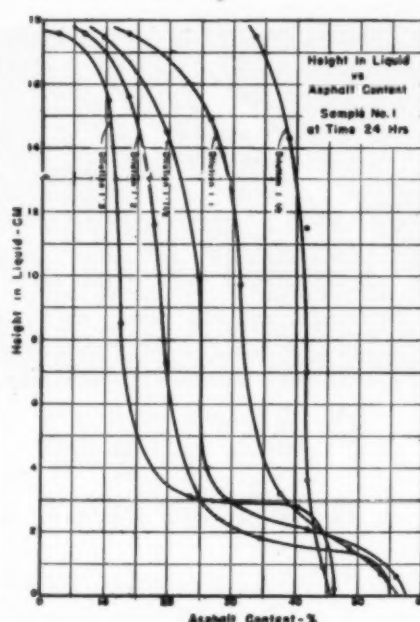


Fig. 2.—Asphalt Content at Various Heights of Sample No. 1 in Definite Height of Liquid After 24 Hours Settlement. Various Dilutions Shown

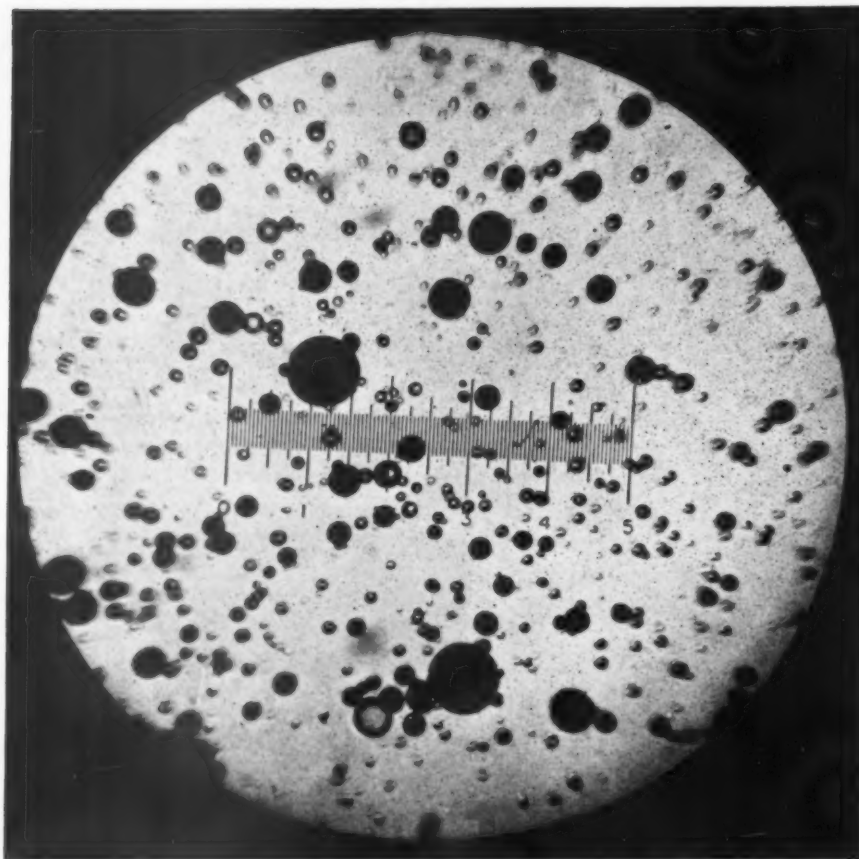


Fig. 3a.—Photo-micrograph of Sample No. 1, Field Diameter—150 Microns, Field Depth—20 Microns; X760

Due to the delay of acceptance of the material, caused by this test, Mr. C. A. Downing has proposed a test¹ to take its place, which may be run in a few hours, allowing the material to be accepted in one day. This

¹ A study concerning a Modification of the Present Miscibility Test and Its Relationship with Probable Settlement Results: Proceedings of A.S.T.M., Vol. 35, 1935, 1935, Part II. Test further modified as described in Proceedings of Association of Asphalt Paving Technologists, Chicago Meeting, February 1, 1939.

test, known as the Downing Modified Miscibility Test, may be briefly described as follows:

50 ml. of the emulsion at 20–25 degs. C., followed by 150 ml. of distilled water at 20–25 degs. C., are placed in a 400 ml. beaker and thoroughly mixed. The beaker and contents are allowed to stand undisturbed for 2 hours at 20–25 degs. C., after which time one gram portions are carefully removed by means of a special glass tube from each of the following levels below the surface: 1 cm., 2.5 cm., and 4.6 cm. The asphalt content is determined in each portion and the maximum difference between levels is computed. A difference of 4.1 per cent² or more constitutes cause for rejection.

Comparative tests by both methods frequently do not give parallel results. Five emulsions selected at random were compared in this way and found to be different. The purpose of this article is to report these results and to present the conclusions from exhaustive studies of the various controlling factors in each method.

Test Evaluation Work

In the attempt to evaluate this test, a large number of determinations were made on five emulsified asphalts representing three types of emulsion from two sources. The sample designations are given in Table I. The routine analysis of these materials is shown in Table II.

The results of the Five Day Settlement Test are shown in Table III, and the results of the Downing Modified Miscibility Test in Table IV.

The Five Day Settlement exceeded 5 per cent in only one case, while the Downing Miscibility exceeded 4.1 per cent in every case except one. Thus, of the five emulsions four are well outside the limit on the Miscibility results while only one would be objectionable from the standpoint of settlement.

Examination of Table II will reveal that the Five Day Settlement is well in accord with the specific gravity difference between the asphalt and the liquid phase. Those having the greatest difference showed the greatest settlement. Other factors affecting the test are: particle diameter, viscosity of the aqueous phase, tendency of the particles to coagulate and asphalt content. With the possible exception of coagulation, these factors seem to be of much less importance than the gravity difference.

Examination of Table III shows that by far the greatest change in the asphalt content occurs in the top portion. The change in the bottom portion is comparatively small, even in the case of Sample No. 4 which settled badly. This indicates that settlement of the undiluted emulsion is mainly due to the particles packing more closely to-

² The latest proposed A.S.T.M. specification for slow setting emulsified asphalt for fine aggregate mixes sets this limit at 4.5%.

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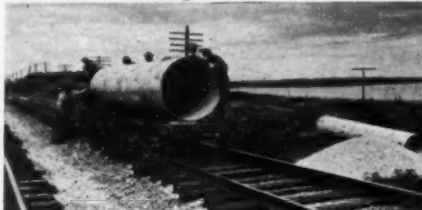
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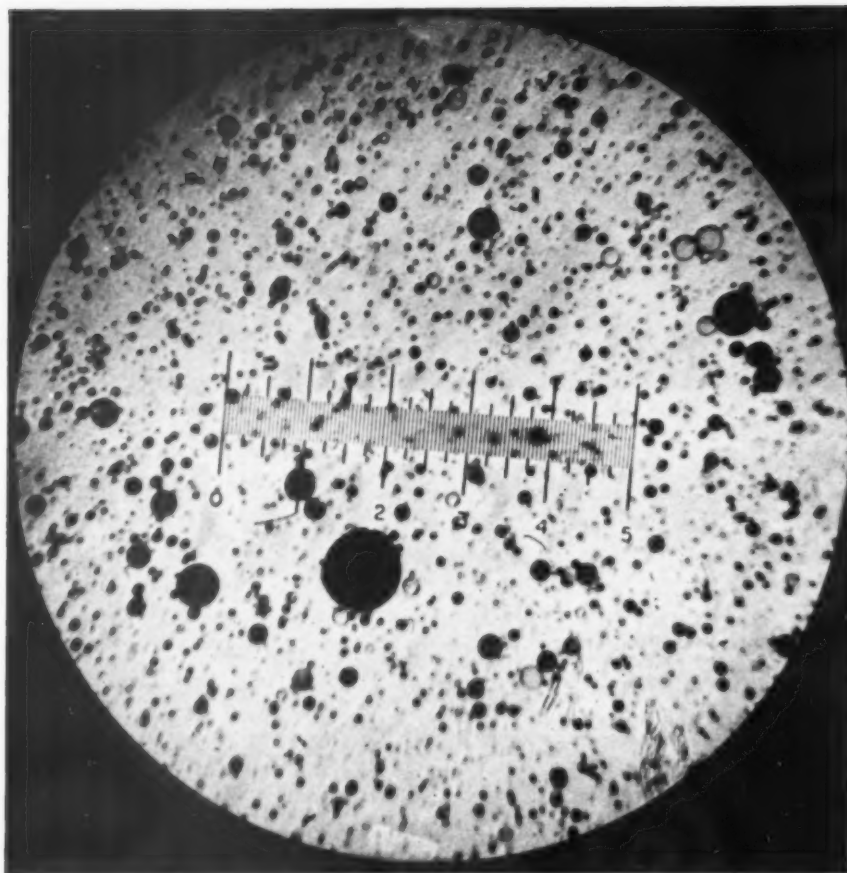


Fig. 3b.—Photo-micrograph of Sample No. 1, Field Diameter—360 Microns, Field Depth—46 Microns; X316

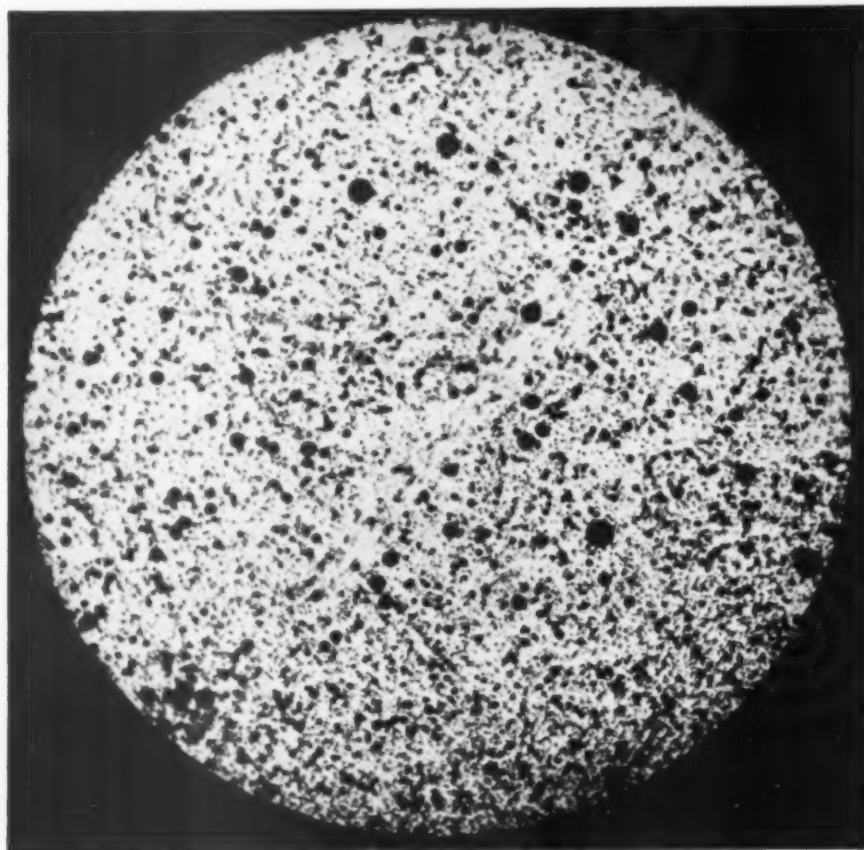


Fig. 3c.—Photo-micrograph of Sample No. 1, Field Diameter—1470 Microns, Field Depth—96 Microns; X78

gether, driving the liquid upward, rather than a migration of the larger particles to the bottom. (All these directions obviously would be interchanged if the asphalt were lighter than the aqueous phase.)

As the emulsion is diluted, the mutual interference of the particles is diminished and the settling takes on a different nature. The particles begin falling individually, their speed of settlement being controlled principally by the variables in Stoke's Law.

Effect of Dilution.—To demonstrate the difference in nature of the settlement as the emulsion is diluted, several tests were run on Sample No. 1. This emulsion, being very stable, was selected for these tests because of its ability to remain unchanged during the length of time necessary to complete the investigation.

Samples of the emulsion, diluted 1:½ (1 part of emulsion to ½ part of water by volume), 1:1, 1:1½, 1:2 and 1:3 with distilled water was placed in 8-inch test tubes to a height of 17.8 cm. (7 inches). The tubes were then stoppered and set aside in an upright position. At various time intervals, the asphalt content was determined at several heights in each tube. The results are shown in Figures 1 and 2 at intervals of 2 and 24 hours, respectively. At the dilution of 1:3 (that used in the Downing Miscibility Test), as indicated by the lower portion of the curve, the asphalt content changes sharply at about 3 cm. The region below this point represents a concentrated portion created by the larger asphalt particles that have individually settled through the suspension and have piled up on the bottom. Visually, the line of demarcation between the concentrated portion and the thin portion above it was very distinct at 24 hours and fairly distinct at 2 hours. Thus it is evident that the settlement in a 1:3 dilution is principally the migration of individual particles toward the bottom. Referring again to Figure 2, the concentrated lower portion becomes more obscure as the dilution is decreased, and at a dilution of 1:½ this portion has practically disappeared—indicating that the settlement is taking place principally by a process of thickening rather than a migration of individual particles toward the bottom. The predominance of "thickening" over the migration of individual particles as a process of settlement is of course even more pronounced in the undiluted emulsion. It is not to be denied that extremely large particles will still tend to migrate toward the bottom.

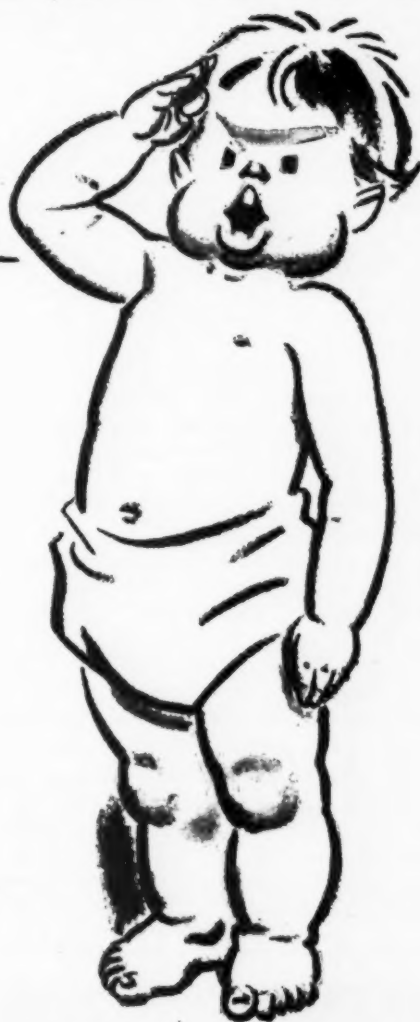
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ORDER OF THE DAY

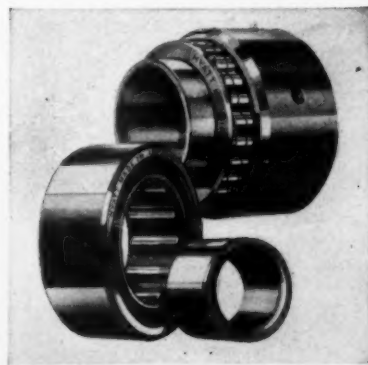
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QUIET

WILLIMANTIC AIRPORT EXTENDED

An earth moving job of considerable proportions is in progress at Willimantic, Connecticut, where nearly 900,000 cubic yards of fill are being moved by the Work Projects Administration, in the process of extending the municipal airport for defense and commercial uses.

From one hillside 600,000 cubic yards of earth are being cut and used as a fill for the locally famous "Frog Pond," which, legend has it, is bottomless. Cuts as deep as 37 feet are being made elsewhere and the total cut-and-fill will approach the 900,000 cubic yard mark.

The Willimantic airport, the only major field in north-eastern Connecticut, has been certified by the War Department as of considerable importance to national defense.

Prior to the start of the current WPA projects, the airport had two 500-foot wide landing strips each 3,000 feet in length, running north-south and east-west. The work now in progress will extend the east-west landing strip an additional 500 feet to the east, and provide a 4,500-foot, northeast-southwest landing strip, which will also be 500 feet wide.

The present landing strips are laid out, roughly, in a T-shape. The hillside which is to be cut away juts into the south-west angle of the "T." The slope, of which it is a part, is being cut back at the eastern end of the field. Parts of this cut reach a height of 37 feet.

"Frog Pond," the legendary bottomless body of water, will require fill to the depth of at least 40 feet to bring it up to the level of the landing field.

More than 75,000 cubic yards of earth were moved by the WPA crew of about 65 men during the first month of the project's operation. Currently the work is progressing at the rate of about 5,000 cubic yards each working day, and the expected early addition of four power shovels to the three already in use will double the

speed of the excavation. Some 20 trucks will also be added when the new shovels are put on the job.

The excavation and grading are the WPA end of the airport improvement job as the present project does not include the paving of the runways or the erection of airport buildings. Some drainage work, however, is being done by the WPA and a service road is to be constructed around the field.

WASHTENAU COUNTY, MICHIGAN, ROAD COMMISSIONERS ANNUAL REPORT

In compliance with the statute relating thereto we take pleasure in submitting herewith our Twenty-Second Annual Report . . ." So reads the letter of the county road commissioners in transmitting their report to the Board of Supervisors. While the preamble given is usual in such cases the report itself is excellent in that the 34 page book is most complete. It not only contains the usual financial statement but also contains a full discussion of the work undertaken by the Road Commission, with illustrations of many of the projects before and after the improvements were made and in some cases a description of the legal and engineering aspects of the improvement. The report explains for the benefit of the Board of Supervisors and the taxpayers which the board represents the reason for the actions of the Road Commissioners when new equipment was purchased or a new material or method was used. As an example, on page 9 the second paragraph reads: "Our satisfactory experience during 1939 with a recently developed chemical, viz., calcium magnesium chloride prompted us again to place this liquid on the seven mile road . . ." This is followed by an analysis of cost of using calcium magnesium chloride compound to other materials previously used for the same purpose.

UNUSUAL FEATURES FOR PROPOSED ROAD

Plans reported for construction of a highway in Utah connecting U. S. 40 and U. S. 50 takes into consideration the important factor of the effect of grades and curves on the movement of truck traffic. Newspaper accounts state, "Easy grades and few curves on the proposed highway will make it ideal for trucking livestock, as well as for general travel."

Much study and attention has been given the engine performance factor and the possibility of constructing slow traffic side lanes on grades as methods of dealing with slow movement of trucks over hills, and it appears that at least one state will tackle this problem through reduction of grades on new construction.

TURNPIKE RECEIPTS HIT NEW HIGH

Receipts on the Pennsylvania Turnpike reached an all-time high since this super-highway was opened last October. Tolls collected during May totaled \$275,000 from 239,824 motor vehicles.



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MAKERS OF LANTERNS FOR THE WORLD

(Continued from page 62)

From the foregoing it is evident that the mechanism of settlement in the Downing Miscibility Test is entirely different from that occurring in the A.S.T.M. Five Day Settlement Test, in which the undiluted emulsion is employed.

Nature of Settlement Investigated

To more thoroughly investigate the nature of settlement in a 1:3 dilution, a number of tests were run to determine how nearly the settlement obeyed Stoke's Law. This was done by comparing the particle size grading curve obtained optically with that obtained by a settling method, based on Stoke's Law. Both methods follow. Sample No. 1 was employed for these tests.

The particle size grading was determined optically in the following manner:

A dilution was prepared by mixing one part by volume of the undiluted emulsion with fifteen parts of 10 per cent gelatin solution. This gives a dispersion containing 3.75 per cent asphalt by volume. A drop of this dispersion was placed on a microscope slide and covered with a cover-glass, great care being taken to make the sample representative. Two photo-micrographs of each were made under three magnifications as follows: X760, X316 and X78, making a total of six prints. One print under each magnification is shown in Figures 3a to 3c.

The appropriate ranges of sizes under each magnification were measured and counted. The total volume of the particles in each range of sizes was then computed and divided by the total volume of asphalt in the field

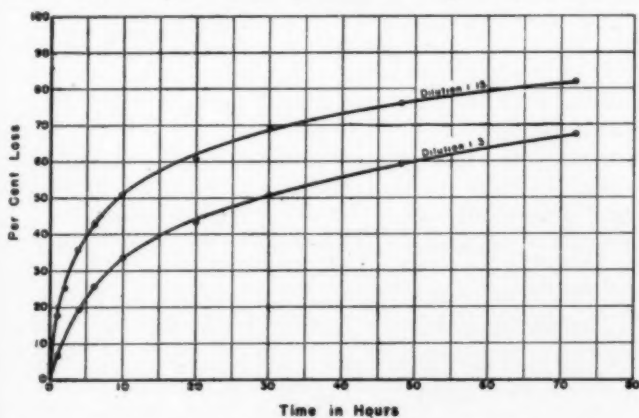


Fig. 4.—Settlement of Asphalt with Time in Diluted Emulsions. Sample No. 1 Diluted with Water

in which it was contained. Thus the percent by volume (or weight) of each size particle was obtained, from which a cumulative grading curve based on volume or weight was obtained.

Theoretically, if the settlement of the particles in suspension follows Stoke's Law exactly, this same curve could be obtained by a settling experiment.³ The following modification of the experiment was applied to sample 1:

A file mark was placed about 1½ cm. below the top of an eight inch test tube and another mark placed exactly six cm. below the first one. Ten such tubes were prepared and filled with diluted emulsion to the top mark. The tubes were then stoppered and the asphalt allowed to settle. At intervals of ½, 1, 2, 4, 6, 10, 20, 30, 48, and 72 hours the liquid between marks was carefully removed from successive tubes by means of a pipette and placed in flasks. After thoroughly shaking, the asphalt contents of the removed liquids were deter-

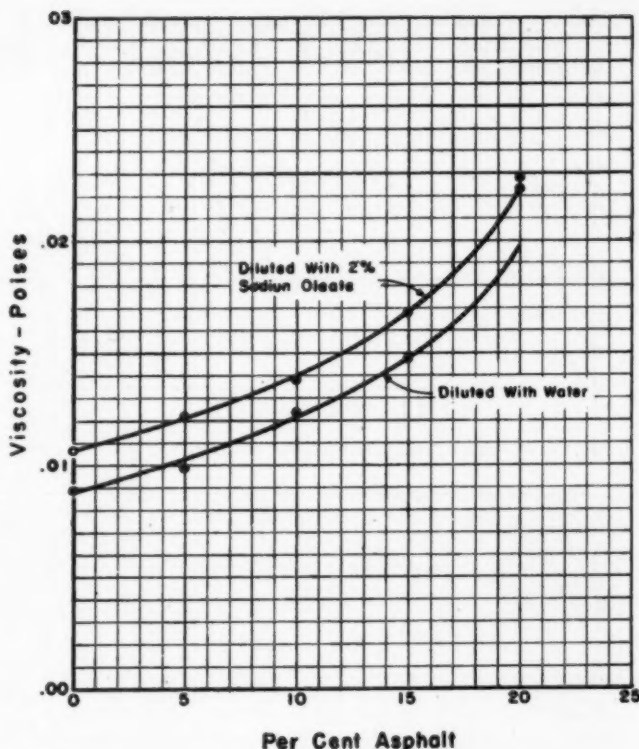


Fig. 5.—Viscosity Curves. Sample No. 1 Diluted with Water and with 2 Per Cent Sodium Oleate

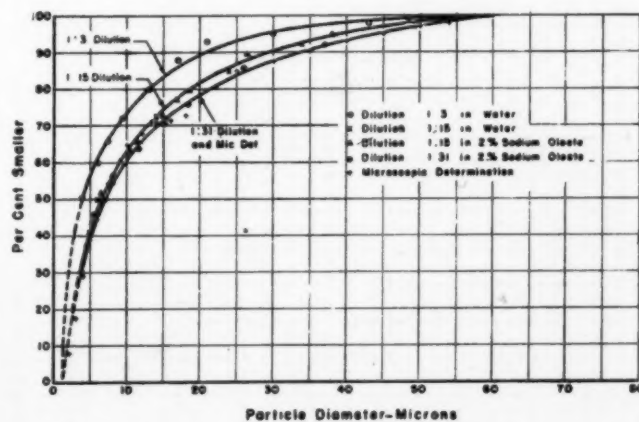


Fig. 6.—Grading Curves, Sample No. 1, Obtained from Settling Tests, Compared to Microscopic Determination

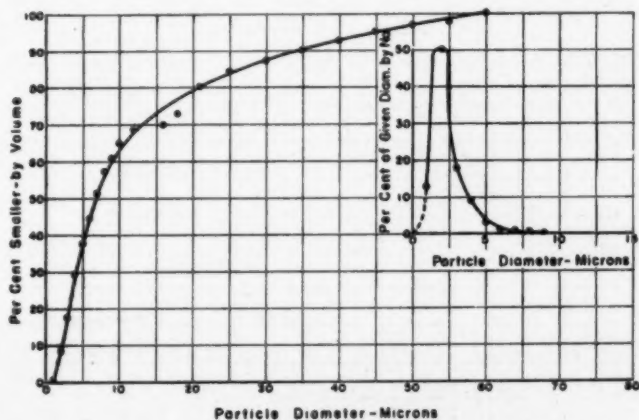


Fig. 7.—Grading and Distribution Curves, Sample No. 1

mined and the losses based on the original asphalt content calculated. Six such tests were made, using varying

³ Holmes: "Laboratory Manual of Colloid Chemistry," page 2.

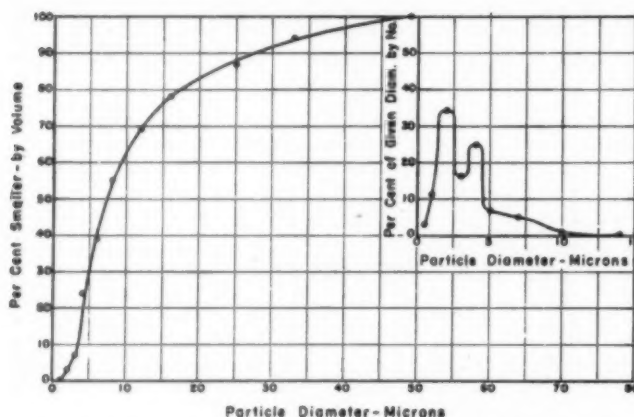


Fig. 8.—Grading and Distribution Curves, Sample No. 2

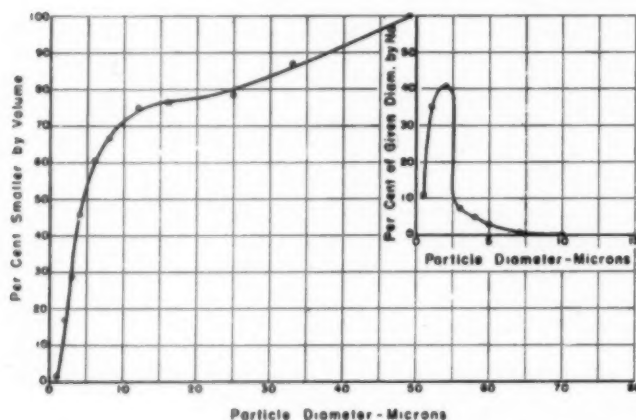


Fig. 9.—Grading and Distribution Curves, Sample No. 3

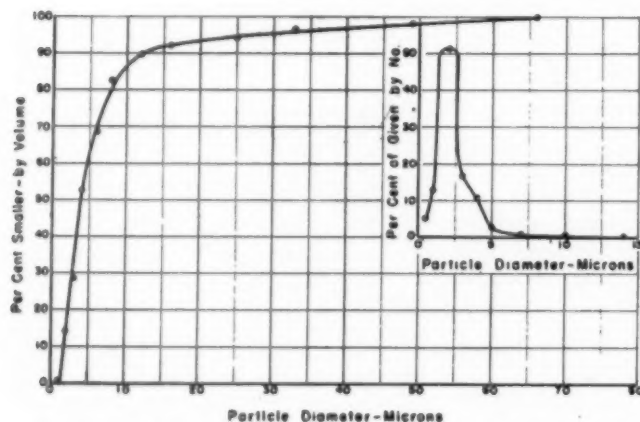


Fig. 10.—Grading and Distribution Curves, Sample No. 4

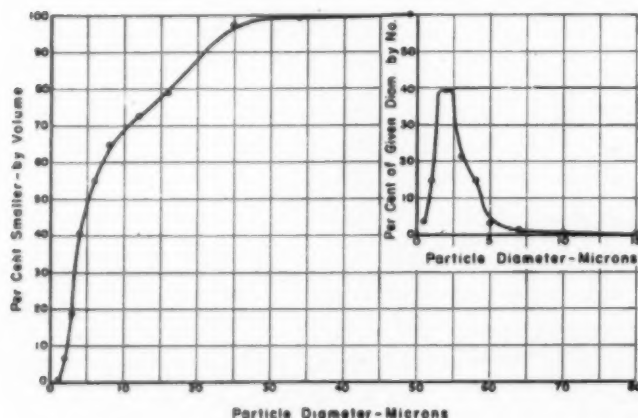


Fig. 11.—Grading and Distribution Curves, Sample No. 5

concentrations of emulsion in both water and 2 per cent sodium oleate dilutions. Typical settling curves obtained by this procedure are shown in Figure 4.

Effect of Stoke's Law.—The grading curves are obtained from the curves in Figures 4 and 5 by the application of Stoke's Law.

$$d = 10^3 \sqrt{\frac{30nS}{980 \Delta G t}}$$

d = maximum size particle in microns, in suspension at a point S cm. below the surface.

n = viscosity of the liquid in poises.

S = depth in cm. (6 cm. in this case).

ΔG = specific gravity difference between dispersed and aqueous phase.

t = time in minutes.

Examination of Figure 6 reveals that the 1:3 dilution curve calculated from the settlement data very closely approaches the actual grading curve obtained from the microscopic determination. The fact that the curves obtained from the settlement data do not become incident with the optically determined curve until a dilution of 1:31 is reached, shows that the mutual interference of particles is still existent to some extent in the 1:3 dilution. Nevertheless the close proximity of the 1:3 curve to the actual grading curve shows conclusively that the speed of settlement is controlled by the variables in Stoke's Law, namely, particle size, viscosity of the dilution, (considered as effective viscosity in this case), and specific gravity difference between the asphalt and liquid phase.

It is noted in Figure 6 that the curves for 1:15 dilution in both 2 per cent sodium oleate and water are coincident, showing that no coagulation occurred due to dilution with water. It certainly follows that no coagulation took place in this emulsion at 1:3 dilution.

Variances Discussed.—In order to account for the results obtained in the Downing Miscibility Test, the viscosity, density difference and particle size range were determined on each of the five emulsions under consideration. The results of these tests are given in Table II and in Figures 7 to 11.

The specific gravity difference was determined by the following formulae:

1. Undiluted emulsions:

$$\text{Difference} = S_a - \frac{S_o (100-A)}{100-S_o A}$$

2. Diluted emulsions:

$$\text{Difference} = S_a - \frac{S_o (100-A) + 100N}{100 - \frac{S_o A}{S_a} + 100N}$$

S_a = specific gravity of asphalt.

S_o = specific gravity of emulsion.

A = asphalt content of original emulsion in percent by weight.

N = number of times emulsion is diluted minus 1.

The viscosities were determined by means of the Ostwald Pipette. A procedure similar to that given for the determination and calculation of particle diameter and grading on Sample No. 1 was used on the other four emulsions except that the count was made directly—pictures not being taken.

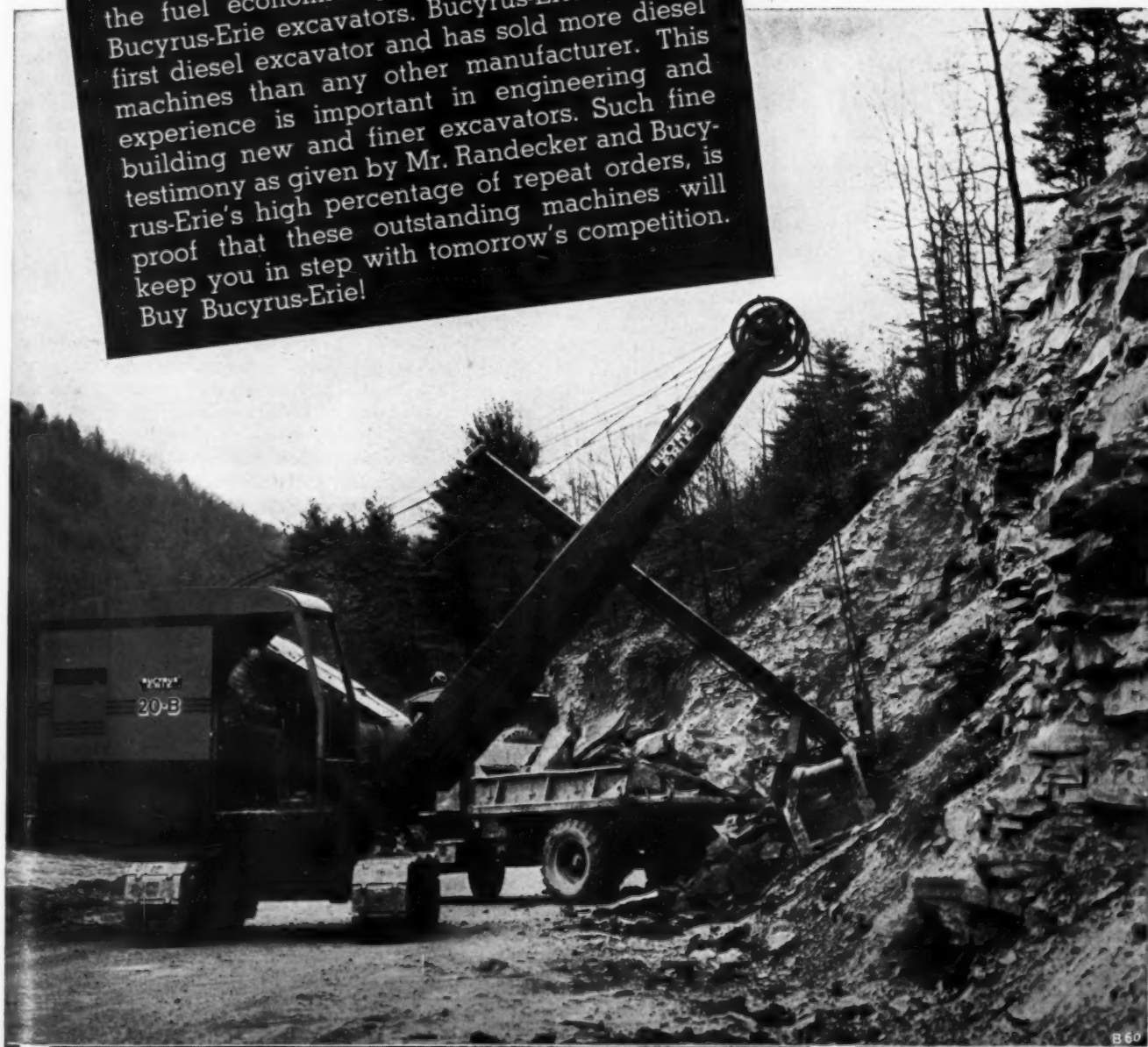
The consideration of these factors in connection with the settlement test and the miscibility test successfully explains all of the results and the miscibility test acquires a different significance.

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S O U T H M I L W A U K E E , W I S C O N S I N

Consider Samples Nos. 1 and 2. Both gave well below 5 per cent by the Five Day Settlement Test but failed the Downing Miscibility Test. The viscosities of the two at 1:3 dilution were fairly close together and the gravity difference after dilution was somewhat greater in No. 2. Consideration of these two factors, alone, would point to the miscibility results running higher for No. 2, whereas the opposite was found to be the case. This is explained by the fact that Sample No. 1 has a much greater content of large particles as seen in the grading curves, Figures 7 and 8. In a 1:3 dilution only the larger particles settle appreciably in two hours, but there is a sufficiently large content of these to give a high result.

Samples No. 3 and 1 in 1:3 dilutions have about the same viscosity, specific gravity difference and particle size grading so they should give about the same miscibility results—which they did.

Sample No. 4 failed the miscibility test badly. Microscopic examination of the 1:3 dilution revealed large stable clusters showing that coagulation in the diluted state had been the primary cause of the miscibility result. No coagulation was observed in the other four samples.

The 1:3 dilution of Sample No. 5 has the same density difference as that of Sample No. 1 but it passed the miscibility test. This is due to its very low large-particle content. For instance, it contains only one percent by weight of particles of greater diameter than 30 microns, whereas No. 1 contains 13 percent and No. 2 contains 8 percent of its asphalt in particles of diameter greater than 30 microns.

In the settlement test where the undiluted emulsion is involved, the process is chiefly that of thickening where the aqueous phase flows upward through the voids as a result of a specific gravity difference. The average void size is about the same for more emulsions so the settlement result depends chiefly on the specific gravity difference.

Conclusions

It is apparent from the foregoing data that the results of the Downing Miscibility Test and of the Five Day Settlement Test are governed by different factors. An emulsion which is well adjusted to eliminate settling may fail the Downing Test badly as was the case in samples Nos. 1, 2, and 3. This is due to the change of specific gravity of the aqueous phase by the added water which destroys the equality of specific gravity of asphalt and aqueous phase in the original emulsion.

The producer using slightly heavier asphalt is obviously being penalized.

The miscibility test, however, has other possibilities. With the gravity difference between phases determined and taken into account and with sufficient supporting data, the test would indicate the tendency of the material to coagulate upon dilution and also reveal an excess of large particles in the emulsion. The comparison of parallel tests in sodium oleate and water dilutions would show the tendency to coagulate while the results obtained in sodium oleate, with due correction for specific gravity difference, would give an indication as to the large-particle content. The test should be especially good in this respect since the speed of settlement varies with the square of the particle diameter, making it the predominant factor in the test. However, this characteristic of the test could certainly not form a basis of acceptance or rejection of emulsions until it is proven that a definite variation in quality exists due to a variation in particle size of this order.

Discussion

By C. A. DOWNING

*Formerly Engineer in Charge,
Municipal Testing Laboratory,
St. Louis, Mo.*

Messrs. Martin and Swearingen are to be complimented on this very carefully conducted study and the data which they have brought out will be interesting to all emulsion technologists. In general, I can say in opening that the conclusions which they have reached are those in which I can concur, although from some of the authors comments in their paper, it would appear they have assumed that my test method was primarily designed as an equivalent of the standard Five Day Settlement Test, whereas it was primarily designed as a quantitative substitute for the standard Miscibility Test.

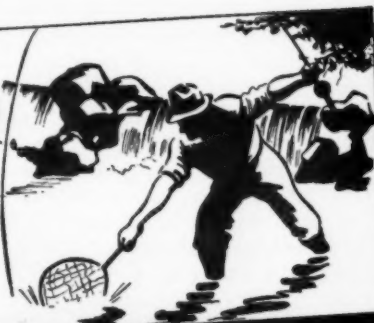
The City of St. Louis, with which I was associated as Chief Testing Engineer during the period when this test method was developed, was a large user of emulsified asphalt, principally of the fine aggregate mixing type. I was very much dissatisfied with the standard Miscibility Test to determine coagulation, because it was not quantitative, and because I believed that coagulation was not readily visible, except in extremely poor emulsions. The primary purpose of the test was therefore to determine whether an emulsion was sufficiently unstable to permit premature coalescence of asphalt particles upon dilution with distilled water.

After developing this test method and using it unofficially as a check test for some time, I discovered that the emulsified asphalt which showed a difference between top, middle and bottom strata of not more than 4.1 percent, also passed the Five Day Settlement Test. In most instances, emulsions which passed the Five Day Settlement Test also passed the Modified Miscibility Test. There were a few isolated exceptions to this rule, which I believe were due to emulsions having been doped by adding ingredients to abnormally increase the specific gravity of the aqueous phase.

The Miscibility Test thus developed as a substitute for the Settlement Test was not a mere coincidence, because as pointed out in the paper under discussion, the Settlement Test is definitely related to Stoke's Law, and so also is the Modified Miscibility Test. With the Settlement Test, however, the aqueous phase may be made viscous and of high specific gravity substantially equaling the specific gravity of the asphalt itself. Where this is done, even coarsely dispersed emulsions show but slight settlement or creaming. In the Settlement Test the emulsion is not diluted, and there is a noticeable tendency toward agglomeration, or premature coalescence of particles only in very poorly manufactured emulsions.

When the emulsion is diluted with distilled water, the particles are still in suspension and settlement follows Stoke's Law, but when the emulsion is diluted the specific gravity and viscosity of the aqueous phase are lowered, and settlement of coarse particles is therefore greatly accelerated. In addition to this accelerated settlement due to the lowering of the specific gravity of the aqueous phase, poorly manufactured emulsions also show a rapid increase in particle size due to the agglomeration of the dispersed particles of asphalt. This, of course, greatly accelerates settlement, and within two hours' time, poorly made emulsions show a difference between strata appreciably more than 4 percent. It is to determine this tendency toward agglomeration, or

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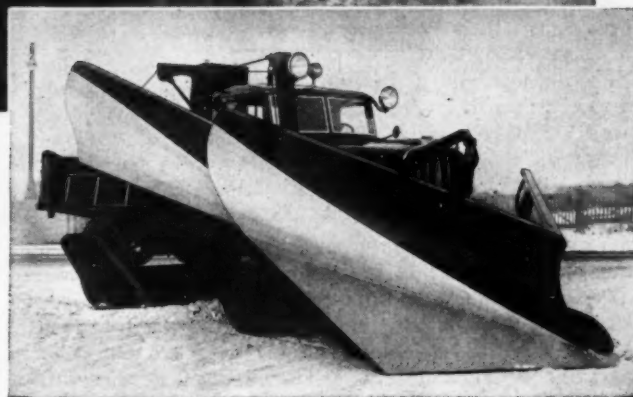


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premature breakdown, that the standard Miscibility Test was designed and has been used for many years.

During my experimental work, test data were collected on 656 different samples of emulsified asphalt between 1934 and 1940. These tests included samples from every manufacturer of importance in the United States, using emulsions made from asphalt from most of the crude sources utilized in this country. After demonstrating the method to my own satisfaction, it was placed in the St. Louis specifications for two years, with the proviso that emulsions would not be rejected for failure to pass the Modified Miscibility Test, provided they passed the Five Day Settlement and standard Miscibility Tests. During this transition period, it became obvious to me that all well manufactured emulsions, regardless of the source of the asphalt, would pass the Modified Miscibility Test requirement, and from 1936 on, the standard Miscibility and Five Day Settlement Tests were dropped from the City of St. Louis specifications.

During the period from 1934 to 1940, the City of St. Louis purchased emulsions from at least five manufacturers who used asphalts ranging in specific gravity from 1.015 to 1.04. These manufacturers readily met the Modified Miscibility Test using asphalts of these widely varying specific gravities. Relatively few rejections were found necessary, and as these brought no serious complaints from the manufacturers, I believe that the defect in the emulsions was due to temporary manufacturing difficulties. Satisfactory emulsions were tested which had been made with California, West Texas, East Texas, Oklahoma, Arkansas, Venezuela and Mexican asphalts, and I am sure that the test did not operate to restrict the manufacturer in selection of asphalt.

Time Reduction

The elimination of the Settlement Test, which I found unnecessary when the Modified Miscibility was made, eliminated five or six days delay in the acceptance of shipments, thus saving considerable money for the producer, and also expediting construction work in the City.

The Settlement Test goes much further than detecting any difference in specific gravities of the asphalt and aqueous phase in that it detects the presence of coarse particles in the emulsion because ordinarily, the aqueous phase and asphalt are not balanced in specific gravity, and the rate of settlement is therefore proportionate to particle size. The Settlement Test also reflects premature coalescence in the undiluted emulsion, such as apparently occurred in Sample No. 4 (Table III of the article). This sample shows a tremendous increase in settlement between five and ten days, and I believe that this must have been due to premature coalescence of asphalt particles in the undiluted emulsion. When this emulsion was diluted for the Modified Miscibility Test, the protective films on the particles at the asphalt aqueous interface were obviously greatly weakened by dilution, because in two hours, settlement was so rapid that the asphalt content at the bottom of the sample was practically 45 percent and at the top only 6 percent. This apparently was not due to the coarseness of the initial dispersion, because the average particle size of Sample No. 4 was 3.1 microns. The particle size after dilution with distilled water could probably be calculated by the application of Stoke's Law or by microscopic count. I believe that in either case, it would be found that the asphalt particles were greatly increased in size after dilution, and that this is responsible for the extreme settlement in the two-hour period, which is nearly twice the settlement in the undiluted emulsion in ten days.

That the Modified Miscibility Test is much more effective in detecting the presence of poorly dispersed asphalt is obvious from a comparison of Samples No. 1 and No. 5. As pointed out in the next to last paragraph before the conclusions, these samples had the same density difference after dilution, but No. 1 had 13 percent of the particles larger than 30 microns, while No. 5 had only 1 percent of these larger particles of asphalt. In the undiluted emulsion, it had been possible to hold these coarse particles in suspension by balancing the gravity of the aqueous phase with that of the asphalt, but when the specific gravity of the aqueous phase was lowered by dilution, the coarse particles promptly settled to the bottom. This indicates that a poor dispersion can be doped to meet the Settlement Test, but cannot be doped to meet the Modified Miscibility Test. Fineness of dispersion is universally recognized as a desirable quality in an emulsion, and as mixing emulsions are usually diluted prior to or during mixing, it is also essential that the dispersion remain fine until the asphalt particles are distributed through the soil or aggregate mass.

I believe that the splendid work done by Messrs. Martin and Swearingen conclusively demonstrates the efficiency of the Modified Miscibility Test in the selection of properly dispersed and properly stabilized emulsified asphalts which will not prematurely coalesce.

The authors' suggestion that the Miscibility Test be made with water and with sodium oleate solution is a very useful one and will doubtless produce much interesting information, as it will distinguish between settlement due to poor dispersion and settlement due to coagulation.

For a further discussion of my viewpoint and observations with reference to the Modified Miscibility Test, you are respectfully referred to my original paper in Volume 35, Part II, Page 546 of the Proceedings of the A.S.T.M., and to my paper in the Proceedings of the Asphalt Paving Technologists, Volume 10 (January, 1939) Page 242.

SOIL MECHANICS DATA AVAILABLE

Interested in Soil Mechanics? Proceedings of the Third and Fourth Texas Conferences on Soil Mechanics and Foundation Engineering are available at \$2.00 each. There is only a limited supply. For copies write to Prof. R. F. Dawson, Testing Engineer and Assistant Director, Bureau of Engineering Research, University of Texas, Austin, Tex.

Highway Accident Property Damage Averaged \$8,000 per Day.—During the first three months of this year nearly 5,000 accidents were reported on the 10,000 miles of Indiana state highways, including routes through cities, with 154 persons killed, 2,409 persons injured and with property damage amounting to nearly three-quarters of a million dollars. These figures do not include fatalities, injuries and property damage resulting from accidents on county roads and city streets which are not a part of the state highway system.

Indiana Traffic Increased 18 Percent Over May, 1940.—Traffic flow on the Indiana state highway system during May was 14 percent higher than in April and 18.5 percent greater than in May, 1940. Each of the 18 automatic counters which register the passage of vehicles day and night, showed a heavier traffic flow during May than for the same month in 1940. The highest increase was registered by a counter on Road 67, south of Muncie, which indicated a gain of 41 percent in traffic.



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Clearing and Grubbing Some Sections Was Part of the Necessary Procedure



THE MINIMUM ROAD

A Paper Presented at the Twenty-Seventh Annual Highway Conference at the University of Michigan

By OTTO S. HESS

*Engineer-Manager, Kent County Road Commission
Grand Rapids, Michigan*

WHAT is "The Minimum Road"? Before expressing an exact definition of this term, it might be advisable to ask where such a road may be found. In Michigan there are thousands of miles of roads which lie in this classification with respect to traffic volume. This vast mileage of roads is largely unimproved. As a rule, these roads do not form connections between towns or other important points, but rather furnish local highway service to farms or other local activities. They are often erroneously referred to as land use roads. This term is far too limited to serve as a correct definition.

Classification

Many of the roads, each of which might be classified as a "minimum road", serve as rural mail routes, school bus routes, and highways for milk trucks, farm produce trucks, and many other transportation activities. Nearly all of these roads are used for other purposes than solely by the adjoining property owner. In addition to ordinary highway service we should not forget that these



In Some Cases End Haul with an Hydraulic Scraper Was Required

roads are also regularly used by the doctor, the minister, the social worker, and in many cases by rural fire apparatus. [And in large percent, by those on recreation bent.—Ed.] As long as these roads are unimproved they are necessarily wholly or partially out of service during portions of every year. They should be improved to an extent which will minimize this lack of service. Inasmuch as the volume of traffic is small, economic limitations dictate that the type of improvement shall be relatively inexpensive. At the same time it must be a sufficient improvement to permit economic maintenance operations by up to date maintenance equipment.

Following are some of the requirements which the minimum road improvement must meet:

1. After improvement, this road must furnish nearly year 'round service.
2. The surface must be capable of supporting a small volume of trucks carrying loads up to the legal limit.
3. The width should be sufficient for two vehicles to pass without undue difficulty.
4. The surface should consist of material which can be economically maintained in a reasonably smooth condition at all times.
5. Drainage must be satisfactorily taken care of.
6. While grades and alignment may be relatively extreme, these factors in the design must be sufficiently good to provide reasonable safety for motor vehicle operations.
7. Last but not least, the completed road must provide an improvement which will permit reasonably safe and economic operation of modern maintenance equipment, such as motor graders, maintenance trucks, and snow plows.

Definition

With this in mind, "The Minimum Road" may be defined as the least expensive improved road which will provide a nearly year 'round service for a relatively

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Cartridge for Cartridge Replacement
Table Comparison of Hercomites 2 to 7
With Other Explosives

	Approximate No. $1\frac{1}{4}$ " x 8" cigs. per 100 lb.	Approximate weight strength	Nearest Extra grade by bulk
Hercomite 2...	240	65	50%
Hercomite 3...	260	65	40%
Hercomite 4...	280	65	40%
Hercomite 5...	306	65	30%
Hercomite 6...	330	65	25%
Hercomite 7...	350	65	20%

Extra Dynamite—Strengths: 20% to 60%. 216 to 220 cartridges, $1\frac{1}{4}$ " x 8", in 100 lbs. For general all-round work. Extensively used for clay blasting, road construction, stump and boulder blasting, quarrying, and electrically fired ditch blasting.

Straight N. G. Dynamite—Strengths: 20% to 60%. 208 to 220 cartridges, $1\frac{1}{4}$ " x 8", in 100 lbs. Sensitivity of the 50% and 60% grades adapts them to propagated ditch blasting, and for accelerating fill subsidence in constructing roads through swamps. Also used for demolition (40%-60%), mudcapping hard boulders (40%-60%), and submarine blasting (60%).

Herculites*—Strengths: 20%, 30%, and 40%. They are free-flowing, ammonia type powders, packed in bags. Satisfactory for general blasting where free-flowing powders of this strength are needed. Herculite 2 (20%) is used for gully blasting in controlling soil erosion.

Gelatin—Strengths: 20% to 80%. 164 to 204 cartridges, $1\frac{1}{4}$ " x 8", in 100 lbs. It is dense and plastic; is more water resistant, less bulky, and produces a smaller amount of objectionable fumes than other

high explosives. Particularly desirable where concentrated loads, or great resistance to water, are required.

Gelatin Extra—Strengths: 25% to 90%. 180 to 208 cartridges, $1\frac{1}{4}$ " x 8", in 100 lbs. Water resistance and fumes satisfactory for tunnelling, mining, and quarrying. Gelatin Extra has almost entirely replaced Gelatin grades for reasons of economy; but for the same reason, Gelatin Extra is often replaced by the Gelamites.

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small volume of mixed traffic and at the same time furnish a road which can be satisfactorily maintained with reasonable economy.

Kent County Experience

Now let us see what type of improvement will fit this definition. A solution to this problem in Kent County would also be a solution to the same problem in a large share of the counties in Michigan. Therefore a brief description of what we have been doing during the past two or three years is apropos.

The Kent County Road Commission started a type of program which we chose to call the "Turnpike Program". A budget was set up of sufficient size for an expenditure of \$1,000.00 in each township. The township was then advised that the county would be willing to grade and place the necessary drainage structures for a mile of road provided the township would be willing to furnish \$500.00 to be expended for gravel surface. Nearly all of the townships took advantage of the proposal.

Selection of Roads

In order to build a mile of road for \$1,500.00 it was of course necessary to select a road which could be built largely with road construction machinery. It was also necessary that there must be very little end haul of dirt and that the grading could be carried out almost entirely with power graders. Therefore, in each township the county road commission and the township board jointly selected a mile of road for improvement which might be classified as one of the least important roads in the township.

Surveys and Plans

In the case of straight roads it was necessary to establish only the centerline which was usually a section line or quarter-section line. On crooked roads it was necessary to make alignment surveys in order to establish a satisfactory centerline to which to work. There was no computation of earth work and no new grade lines laid out except at occasional, critical points. Ordinarily the centerline was established by setting one line of stakes along the right-of-way line on one side of the road. The road survey included necessary drainage information in order to specify the sizes, types and lengths of drainage structures to be placed.

Construction Methods

These improvements were carried out by a crew operating under our Maintenance Department with the as-



Motor Graders First Shaped the Road. Side Ditches Were About 18 in. Deep. Gravel Was Then Spread Over the Surface



Economical Maintenance of the Gravel Surface Is Part of the Plan

sistance of a limited number of W.P.A. laborers. The first operation on the road consisted of doing the necessary clearing and grubbing to prepare it for satisfactory power grader operations. The clearing and grubbing was carried out by a small crew of W.P.A. laborers working in conjunction with a track-type tractor. The tractor was, of course, used to pull stumps and grubs. The clearing and grubbing operations were next followed by the placing of such drainage structures as were found to be necessary. Extremely abrupt points or humps in the grade were next smoothed out by a limited amount of end haul work which was carried out by the use of a five-yard hydraulic scraper. This machine was also used to remove excess side cut where necessary. Such side cut was always needed in the next hollow to widen the fill and it was carried there by the hydraulic scraper. This end haul work did not occur on all jobs, however, and in some cases was eliminated.

Grading and Finishing

The next operation was performed by a tandem drive power grader. It managed all of the grading operations necessary in building a turnpike road. On practically all of these improvements the grade width was fixed at 24 ft. and usually the ditches were "V" type about 1½ ft. in depth. The back slopes were made with the grader and were about 1½ to 1. A skilled grader operator can complete a job of this kind so that the straight lines of the shoulders and ditches and the appearance of the backslopes is almost as good as more expensive improvements where a great deal of hand labor is utilized for fine grading and trimming. About the only hand labor used in the final trim of these jobs was utilized for sodding or rip rapping ditches on steep grades to prevent erosion. The 24 ft. grade was finished with a crown of about 6 in. The finished grade was left in a smooth condition which, without surfacing, was a big improvement over the old road.

Gravel Surface

Next, a fleet of small trucks hauled the gravel. This was usually bank gravel with only the large stones removed. A truck shovel operating in the gravel pit loaded the gravel directly from the bank onto the trucks. A small quantity of top soil was allowed to mix with the gravel to provide satisfactory compaction. The \$500.00 available for surfacing usually provided from 500 to 1,000 cubic yards of gravel. This was deposited uniformly down the center of the road on the top of the prepared grade. Subsequent smoothing and maintenance operations widened the gravel sufficiently.

(Continued on page 81)

NEW BOOKS

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Publishing Director, ROADS AND STREETS
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D. G. Runner

Assistant Materials Engineer,
U. S. Public Roads Administration



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ent branches of engineering, the public, and other professions. It is arranged in dictionary form. The book fills a need or want in engineering literature. It also initiates the standardization of engineering terms. Valuable appendices include English-Spanish terms; Spanish-English words; German-English aggregate terms; Symbols for Hydraulics; Standard Pump Classifications; Materials for Pumping Various Liquids; Abbreviations for Scientific and Engineering Terms; Symbols for Mechanics, Structural Engineering and Testing Materials; Weights and Measures; Conversion Factors.

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By Delmar C. Runner

Assistant Materials Engineer,
U. S. Public Roads Administration



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gravel deposits hardness or toughness values, how to recognize suitable or undesirable materials, and the source or origin of rock types. It is particularly useful to those engineers charged with the responsibility of materials selection for construction or maintenance work.

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EDITORIAL

BETTER LIVING

BBETTER living from more improved roads is, briefly, what a highway department provides in rendering its public service. The public is daily enjoying the benefits of good roads for many purposes.

Revolutionary changes have been wrought in the modes of living of our people, over a very short span of years, because of the existence of cheap highway transportation; particularly for the farmers and wage earners. Occupations, recreations, education and modern conveniences have all been so vitally affected by the highway and cheap transportation that our lives and the lives of our children are more abundant.

Twenty-five years is a comparatively short span in the life of a people. Yet twenty-five years ago there were no paved highways to speak of. Within that short period of time we have seen the development of a modern highway facility. Because of good roads our entire system of primary and secondary school education has been altered. The little red school house has gone the way of the horse and buggy. Modern consolidated schools have taken the place of the one-teacher schools of twenty-five years ago.

Residents of the city no longer have a monopoly on such services as dry cleaning, ice deliveries, early morning and afternoon newspaper deliveries, the evening dish of ice cream, movies, and dozens of other services. Since rural areas are now practically as easily serviced as city areas, there has been a definite migration of homes from the business section area to nearby rural areas. Business decentralization is becoming alarming to the proprietors of businesses in congested city areas.

Municipalities no longer need spend their idle time in congested cities. Week ends, holidays, and good roads are invitations to the garden spots, beaches, athletic events, and other sports and recreations. Twenty-five years ago these pleasures were available to only a few. They are now afforded by people in all walks of life.

Provincialism, once the barrier to the more abundant life, has disappeared. Americans receive broad educations in travel, alone. Sectional feeling and sectional thinking has been replaced by a unity of national thought brought about principally through the personal contacts afforded by the amazing development of good roads.

And we have only begun!

MUNICIPAL OPPORTUNITIES

MUNICIPAL agencies, for years, have been increasingly insistent upon the extension of federal highway aid to include provision for expenditures within municipalities. These requests, or demands, have been accompanied, also, by claims for a portion of the state-collected gasoline taxes and weight and vehicle license fees. It behooves highway and city engineers to develop a plan for equitable division of funds among state, municipal, and local agencies. Agitation of the municipalities is bound to bring a general reconsideration of the whole road and street financing structure from which totally different considerations and new financing processes may emerge.

Since municipalities, like counties, inject the problem

of a multitude of administrative agencies, and the difficulty of spreading funds among them, most of the decisions relative to construction projects would have to be made by the states as a median agency. First, however, there are two national determinations that must be made:

- a. Amend federal highway legislation to authorize the states to spend federal highway funds for the relief of traffic congestion within municipal limits.
- b. Revision of the rules and regulations governing federal and secondary road funds to permit municipalities to enjoy the benefits of secondary federal aid appropriations.

Fortunately, there is a place from which these funds can come without disturbing the present financing of state highway work. It is represented by the difference between what the federal government collects from gasoline taxes and motor vehicle excise taxes, and the amount it presently appropriates for federal aid to highways. Municipalities and local governmental agencies could do no better than to organize their efforts in a cooperative movement to have Congress give these presently diverted funds as federal aid to municipalities. Likewise, for state diversions. Were they given to municipalities in their respective states these cities and towns would experience a boom in street construction and a welcome relief to traffic congestion.

UNFAIR SPECIFICATIONS

CLAUSES in specifications which hold a contractor responsible for results when he has not been allowed to exercise his own judgment or initiative in producing those results virtually make a contractor responsible for the acts of the engineer. Examples of such clauses are, (1) those requiring a contractor to maintain a piece of construction for a period of years after completion, and, (2) those requiring a contractor to submit designs of formwork for bridge construction to a state highway department for approval before proceeding with construction and at the same time requiring that the contractor be responsible for the finished bridge until accepted by the state.

An article by Leslie Childs which appeared in the trade press within recent months pointed out that a contractor taking on such a proposition was practically hanging himself. Actually he is guaranteeing the work of the engineer when he signs the contract. Even though he finds, during the process of construction preparation, that the engineer's judgment is faulty, he can be held to the letter of the specifications. Under these conditions he has one of two choices, depending upon which is cheaper for him. He may (1) suffer the penalty for non-performance, or (2) suffer the damages if the job "goes sour" or if the structure fails. Only recently, a state highway department required the bidders on a bridge project to design the forms and submit the designs to the state for approval. At the same time the specifications stipulated certain results desired which the contractors were required to guarantee.

Engineers are violating the ethics of the engineering profession in writing such specifications. Contractors are crazy for bidding on jobs governed by them.



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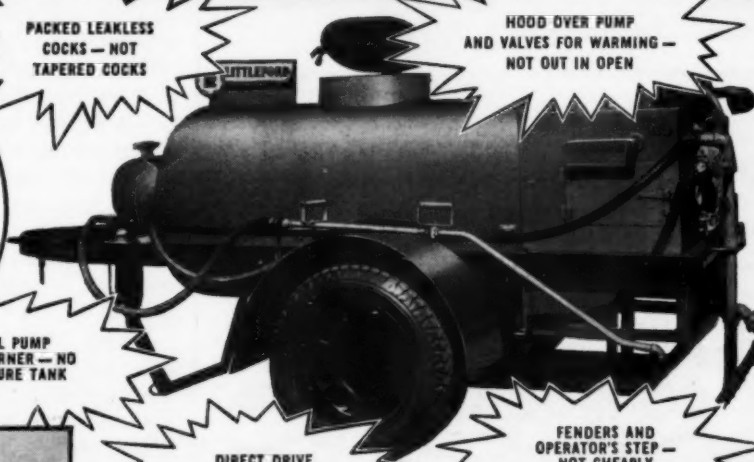
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(Continued from page 41)

At the other fill, four feet of the top was removed with a power shovel and used to widen the base. Here, too, a 44-ft. top was constructed, the surface being brought back to grade by a series of compacted layers of borrow material and will be topped with six inches of mineral aggregate before the new pavement is laid. Checks are to be made on both sections of pavement by the engineers to determine which treatment is the most satisfactory.

Sodding.—Other steps in the streamlining of Route 31 south of Seymour included the widening of the 18-ft. pavement to 22 ft. and resurfacing at some points or the construction of a 22-ft. slab where relocation was carried out to improve grade and alignment for sight distance. Widening of shoulders, flattening backslopes and providing drainage, as well as the sodding of shoulders has been an important corollary of the paving and resurfacing in the development of a modern highway.

Contracts.—The work south of Seymour is included in three contracts, two of which are held by U. R. Price & Co., of Bloomington, Indiana, and the third by the M. M. Best Co., Louisville, Kentucky. Completion dates on these are Oct. 1, Nov. 1, and Dec. 1, 1941.

TRACTOR FUEL

Some Characteristics, Uses And Methods of Manufacture

By J. B. TORRANCE

*Agricultural Extension Division
University of Minnesota*

ONE of the principal questions where the operation of tractors is considered is the choice of the fuel to be used. The subject may be considered from any one of several different angles. The object of this article* is not to furnish a definite answer but rather to present again some information which may be of value in a consideration of the matter.

All of the fuels used in tractors are obtained from crude oil and are known as hydrocarbons containing around 85 per cent carbon and 15 per cent hydrogen. These two elements are combined in a great many different ways, each combination having characteristics peculiar to itself. We will deal briefly with some fuels common in tractor operation and characteristics which should be considered for best results.

These fuels are extracted from the crude oil by distillation processes. The crude is heated in the still, and the various hydrocarbons are driven off as vapors. The lighter, more volatile compounds are expelled at lower temperatures. The heavier, less volatile compounds require higher temperatures for their distillation. A distillation test of fuel indicates the temperatures at which certain percentages of the fuel are vaporized. Table I shows comparative temperatures at which certain percentages of various fuels are recovered through distillation. The "initial point" is the temperature at which the first drop of fuel is recovered from the sample being

* Published as a News Letter in furtherance of Agricultural Extension Act of May 8, 1914, Paul E. Miller, Director, Agricultural Extension Division, Department of Agriculture, University of Minnesota, cooperating with U. S. Department of Agriculture.

tested. The "end point" is the temperature at which the last of the sample is recovered. The entire amount of the sample is never recovered, there being slight distillation losses and a small amount of residue which is not distilled.

TABLE I. TEMPERATURES, DEGREES FAHRENHEIT

	Initial point	20%	50%	80%	End point
Gasoline—					
premium grade	108	166	235	301	386
regular grade	107	169	243	322	397
third grade	112	185	256	335	403
Kerosene	310	390	429	481	517
Distillate	338	407	459	508	537

Before any fuel can be burned in a carburetor type engine, it must be properly vaporized. If, in the process of distillation, a certain temperature was necessary to vaporize the fuel, that temperature will be required to carburate it for good engine operation. This must be kept in mind especially when using the so-called heavier fuels. A study of Table I shows that practically 80 per cent of the gasolines are vaporized by the time the initial point temperature of the kerosene and distillate is reached. This shows the absolute necessity of warming the engine thoroughly before attempting to operate on the heavier fuels. Not only must the engine be warmed properly, but this temperature must be maintained and proper manifold adjustment made completely to vaporize the fuel. The temperature at which the engine will normally run is not sufficiently high for heavy fuel carburetion. Manifold heat is absolutely necessary. Operating conditions have a great effect on operating temperatures. For example, it is not difficult to maintain good operating temperatures when an optimum load is being pulled continually. However, the engine is apt to run much cooler with varying or intermittent loads.

Table II shows another picture. Here we see the weights of the different fuels from premium gasoline weighing 6.08 pounds per gallon to the distillates with an average of around 6.87 pounds per gallon. We also see that while the more volatile fuels have more heat units per pound they have less per gallon, which is the unit by which they are purchased. There is, also, another side to this. While there are more heat units per volume of the heavier fuels, more care must be exercised to make those heat units available for use in the engine. If they are not made available for the engine to burn readily, they are not changed to power, hence are wasted. This unburned fuel washes the lubricant from the walls of the cylinders and pistons and dilutes the oil in the crankcase.

TABLE II. SOME PHYSICAL TESTS OF THE SAME FUELS MENTIONED IN TABLE I

	Sp.Gr. at 60° F.	Weight pounds per gal.	Heat Value (high)	
			BTU per lb.	BTU per gal.
Gasoline—				
premium grade	0.7294	6.080	20,310	123,440
regular grade	0.7335	6.113	20,290	124,500
third grade	0.7345	6.128	20,280	124,785
Kerosene	0.8132	6.778	19,820	133,920
Distillate	0.8251	6.870	19,455	133,700

Greater power may be obtained from an engine by increasing the compression ratio. When this is done, another fuel characteristic is brought to our attention. This is its anti-knock value or "octane" rating. As the compression ratio becomes higher, the tendency toward knocking increases. The anti-knock characteristic of

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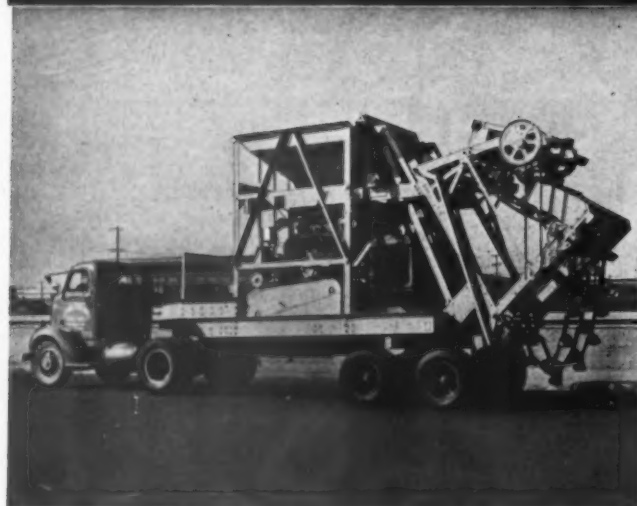


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ENGINEERS AND MANUFACTURERS—

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INDIANAPOLIS, INDIANA

a fuel is changed in one of two ways. Either by adding some anti-knock agent or by changing the method of distillation. This latter method is known as cracking the fuel or distilling it under pressure. Most of our gasolines are obtained in this manner and so have a fair anti-knock rating. This rating is greatly increased in the "premium" grades and in many of the "regular" grades by the addition of "lead." Kerosene being obtained by straight distillation methods has very poor anti-knock qualities. The tractor distillates are obtained both through straight distillation and by cracking. Those obtained by the latter method have a much better "octane" rating and, other characteristics being equal, these are to be preferred as tractor fuels. In fact several of the companies have developed a fuel particularly for tractor use giving it the characteristics necessary for good operation.

It has been mentioned that much, if not most, of the gasoline in use is obtained by the cracking process. The chemical structure of the fuel is changed somewhat in this process. A rather pronounced tendency toward the formation of gummy substances is the result. This substance forms in the tank, sediment bulb, and carburetor particularly when gasoline is left in the fuel system during idle periods. The best remedy is not to allow the gas to remain in the system for any extended period. It is also suggested that the fuel be purchased in such quantities that it will not be kept in storage to exceed 60 days. Any gum which collects in the carburetor or other places such as screens may be removed by a solvent such as alcohol. Some trouble has been experienced with gum forming on and sticking in the inlet valves. Valves of stainless steel and shorter valve guides seem to have remedied this fault.

As yet comparatively few are using tractor engines with compression ratios sufficiently high to require premium grade gasoline. A very small number use kerosene. Perhaps 75 per cent of all operators are using the lower grades of gasoline, and the rest other heavier fuels variously known as distillate, tractor distillate, fuel oil, or tractor fuel.

HIGHWAY DEPARTMENTS USE MORE SMALL TRUCKS

A recent survey to determine various facts about trucks used by contractors and highway departments produced some very interesting figures.

The breakdown by size follows:

Size	Under 1 Ton Percent	1-1¾ Percent	2-3 Percent	3½-5 Percent	Over 5 Percent
Contractor	12.53	40.90	15.71	14.56	16.30
County	11.84	45.65	27.85	8.86	5.78
State	12.01	45.01	31.25	8.05	3.62

It will be noted that nearly half of the trucks used by contractors are 2-ton trucks or larger. However, the state and county highway departments have a predominance of smaller sizes. In both cases roughly ¾ of them are of 1- to 3-ton capacity.

These figures are borne out by the conclusions reached by the Equipment Engineers Group at the Thirty-third Annual Meeting of the Mississippi Conference of State Highway Departments held in Chicago, January 30, 31st and February 1st of this year. The published report reads: "The smaller type of dump truck is preferred by most highway departments, while larger trucks are desirable for snow removal."

(Continued from page 74)

Cost

The cost of completing the grade ready for gravel varied a great deal in different locations. In a few cases the cost was under \$1,000.00; in other cases where considerable end haul was involved or where there was a large amount of clearing and grubbing, the cost was as high as \$2,000.00 per mile. This cost was, of course, also greatly affected by the size and number of drainage structures required. The average cost, however, for all of the jobs complete with gravel surfaces was between \$1,500.00 and \$2,000.00. From this it is readily seen that a considerable mileage of this type of road can be constructed with a relatively small total budget. While the total county participation in the program was only about \$24,000.00 in 1940, the satisfaction and good will created by the Turnpike Program was probably as great as that created by the regular construction program on more important roads which required a budget several times larger. This work has furnished a new lease on life to the people living on the back roads and has made them see that they are no longer the forgotten people of the highway program. Highway officials have little excuse to ignore this phase of our highway development, especially when it is known that it can be carried out with only a relatively small share of the total funds expended for highway construction.

Type Controlled by Local Conditions

There is nothing really new about this program except perhaps the plan of participation with the townships and the use of the most modern construction machinery for this type of work. It is realized that in some sections of the state a type of surface other than gravel may be more economical. The type of construction described here, however, probably fits all but a few counties in Michigan. As a general rule, the type of surface should be selected which will result in the most economical road and which will meet the requirements previously outlined.

Conclusions

To summarize, the following conclusions may be drawn from these remarks:

1. Traffic volume should not necessarily dictate the order of improvement of the various classifications of roads in our total system.
2. For many reasons it is desirable and necessary that the lowest classifications of roads be developed concurrently with the more important groups from the standpoint of traffic volume.
3. A minimum type of road improvement should be adopted for the lowest classification of roads.
4. This minimum improvement must be sufficient to meet the local traffic requirements and also furnish a road which can be maintained with reasonable economy.
5. A 24 ft. grade with a light gravel surface is about the minimum type which will meet these requirements. Under certain conditions a 20 ft. grade width may be justified to save trees, and buildings, or to reduce the construction cost.
6. Grades and alignment may be of much lower standard than those permitted on main county roads. The design should lend itself to a plan of construction by machinery.
7. In order to be successful, this minimum type of improvement must be provided with a plan for continuous maintenance.

TEETH TAPPING

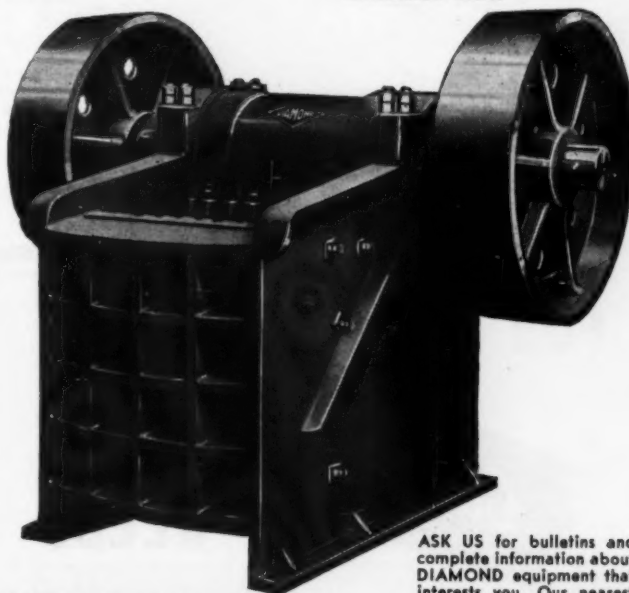
"The origin of Teeth-Tapping, which is the general term applied to sitting with one or both elbows on a desk and tap-drumming rhythmically on the front teeth with a pencil, is a little uncertain. Much of it was done during the late depression. Today, much of it is being done by construction men who are at their wits end to avoid delays, up production and save on costs."

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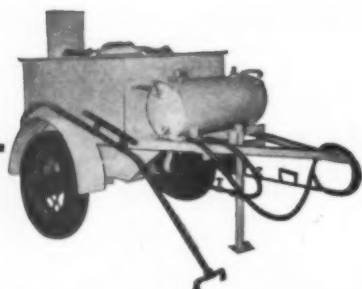
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POWERS' CATALOG

COLUMN

PAGE 43 of the June issue of **ROADS AND STREETS** listed equipment specification changes made since the publication of Powers' Catalog in April. Herewith we list additional changes made between June 1 and July 1.

Specification Changes

Caterpillar Tractor Co.

	Previous	Present Revised
D4 TRACTOR		
Shipping Weight		
Narrow Model	9,910 lb.	9,810 lb.
Wide Model	10,240 lb.	10,050 lb.
Operating Weight		
Narrow Model	10,100 lb.	10,000 lb.
Wide Model	10,400 lb.	10,210 lb.

R4 TRACTOR

Shipping Weight		
Narrow Model	9,420 lb.	9,390 lb.
Wide Model	9,710 lb.	9,620 lb.
Operating Weight		
Narrow Model	9,700 lb.	9,670 lb.
Wide Model	10,000 lb.	9,910 lb.

MOTOR GRADER No. 112

Front Tread	6'8"	6'7½"
Weight on Front Wheels	4,830 lb.	4,800 lb.
Diesel-Tandem Drive		
Shipping Wt.	18,100 lb.	18,000 lb.
Wt. on Rear Wheels	13,270 lb.	13,200 lb.
Diesel-Single Drive		
Shipping Weight	15,000 lb.	14,900 lb.
Weight on Rear Wheels	10,170 lb.	10,100 lb.
Gasoline-Tandem Drive		
Shipping Weight	17,500 lb.	17,400 lb.
Weight on Rear Wheels	12,670 lb.	12,600 lb.
Gasoline-Single Drive		
Shipping Weight	14,400 lb.	14,300 lb.
Weight on Rear Wheels	9,570 lb.	9,500 lb.

MOTOR GRADER No. 12—Diesel

Shipping Weight	21,140 lb.	21,500 lb.
Weight on Front Wheels	5,750 lb.	5,950 lb.
Weight on Rear Wheels	15,390 lb.	15,550 lb.
Max. Shoulder Reach	6'5"	7'4"
Tires—Rear	12.75-24	13.00-24
Engine—Max. H.P.	70	75

MOTOR GRADER No. 12—Gasoline

Shipping Weight	20,500 lb.	20,900 lb.
Weight on Front Wheels	5,750 lb.	5,950 lb.
Weight on Rear Wheels	14,750 lb.	14,950 lb.
Max. Shoulder Reach	6'5"	7'4"
Tires—Rear	12.75-24	13.00-24

BLADE GRADER No. 22

Weight	3,470 lb.	3,575 lb.
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BLADE GRADER No. 44

Weight Hand Controls	7,580 lb.	7,700 lb.
Weight Power Controls	8,180 lb.	8,320 lb.
Blade Pressure without scarifier		
—Power Control	7,740 lb.	8,070 lb.

BLADE GRADER No. 66

Weight Hand Controls.....	10,610 lb.	10,440 lb.
Weight Power Controls.....	11,110 lb.	10,900 lb.

ELEVATING GRADER No. 48

Engine Crank Case Capacity, qt.	22	18
Number of Main Bearings.....	3	7

ELEVATING GRADER No. 42

Height Overall	9'5"	9'2"
Wheelbase	13'6"	13'0"
Wheels—Front Tire Width	12"	10"
Engine Crank Case Capacity, qt.	16	18
Number of Main Bearings.....	3	5

W. E. Grace Manufacturing Co.**TAMPING ROLLER SX112**

	Previous	Present Revised
Weight—Empty	5,000 lb.	6,000 lb.
Weight—Loaded with Water...	8,900 lb.	9,900 lb.
Weight—Loaded with Sand....	12,500 lb.	13,500 lb.
Pressures—lb. per sq. in.		
Empty, lb. per sq. in.....	103	126
With Water, lb. per sq. in....	203	226
With Sand, lb. per sq. in....	285	308
Pressures per Tamping Foot		
Empty	567 lb.	692 lb.
With Water	1,116 lb.	1,241 lb.
With Sand	1,567 lb.	1,692 lb.

Koehring Company**CONCRETE PAVING MIXER 27E-2A**

	Previous	Present Revised
Loading Skip Pan Width.....	112-120"	108"
Loading Skip Hoist Cables.....	5/8"	2-5/8"
Skip Hoist Braking Area (sq. in.)..	130	125
Boom Size	2-10"	1
Tank Discharge Rate (gal./sec.)...	3 1/2	3

CONCRETE PAVING MIXER 34E—Twin Batch—1A

Loading Skip Width.....	112-120"	108"
Loading Skip Hoist Cables.....	5/8"	2-5/8"
Skip Hoist Braking Area (sq. in.)..	125	130
Boom Size	2-10"	1
Number of Rollers (each track)...	16	8

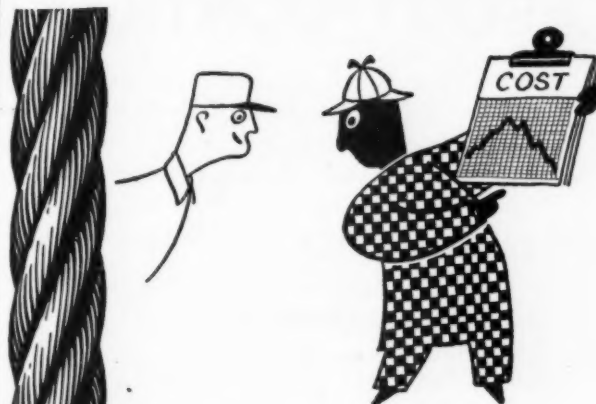
CONCRETE PAVING MIXER 34E—Single Batch—2A

This is a recent addition to the Koehring line. Full specifications can be obtained from the company. We give here a few of the main items.

Capacity (cu. ft.).....	34+10%
Shipping Weight (lb.).....	51,800
Drum (inside diameter × length).....	77"x54"
Drum Drive Type.....	Gear
Drum Speed (R.P.M.).....	15
Loading Skip Width.....	108"
Boom Length	30'0"
Boom Size	2-10" [
Boom Spreading Radius	27'6"
Arc of Boom Swing.....	180°
Bucket Capacity (water level) (cu. ft.).....	60
Bucket Travel Speed (f.p.m.).....	220
Tank Type	Syphon
Tank Capacity (gal.).....	60
Tank Capacity (auxiliary) (gal.).....	120
Main Frame	16" I 58½
Length of Crawlers (overall).....	180"
Tread Shoe Size.....	18 1/2"
Power Unit	Waukesha 140CS
Fuel	Gasoline
Rated Horsepower of Unit.....	105

CONCRETE FINISHING MACHINE (Longitudinal)

Length Overall	11'0" to 30"	9'0" to 30"
Length for Shipping.....	17'6"	13' to 32'



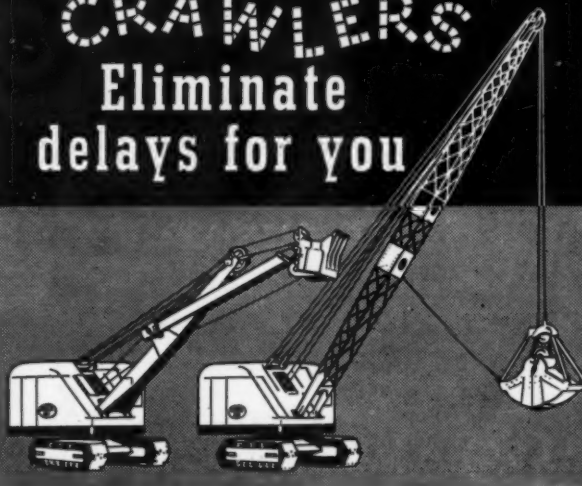
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ABOUT CONTRACTORS *and their* JOBS

The following information is published as reports from field contact men after the style of the former Earth Mover and Road Builder magazine. The editors of ROADS AND STREETS do not verify or check any of the information. It is given here as the reports of men who are constantly contacting contractors in their respective areas.

PITTSBURGH AREA

Reported by
JOHN W. PATTERSON

Housing Projects in Pittsburgh, Pa. and Allegheny County.—More houses seems to be the program for this district

during the coming year. The Allegheny County Housing Authority will spend \$23,000,000 to construct 5000 dwellings in the county.

First of the fourteen projects included in this defense housing program will be in Turtle Creek. Letters requesting sealed bids for the construction of 600 dwellings

were mailed June 16th to contractors all over the United States. For the thirteen other projects similar requests are being sent out, and bids will be opened on successive days beginning June 28th. ACHA Director Frank Palmer claims that actual construction is scheduled to start early in July. The first group of dwellings will vary in size—two, four and six-family units.

Five tons of blue prints (and that's plenty of paper) have poured into the ACHA office from every commercial blue print firm in the county. On each of these prints is an intricate plan minutely detailed showing just what the ACHA wants its dwellings to look like.

Ambitious with a capital "A", the project calls for housing units in almost every hamlet, borough, township, and tiny village near Pittsburgh. Included in the extensive program is New Kensington, a town 25 miles from the "Golden Triangle." With such a far-reaching and inclusive program it is no wonder ACHA is using five tons of blue prints.

* * * * *

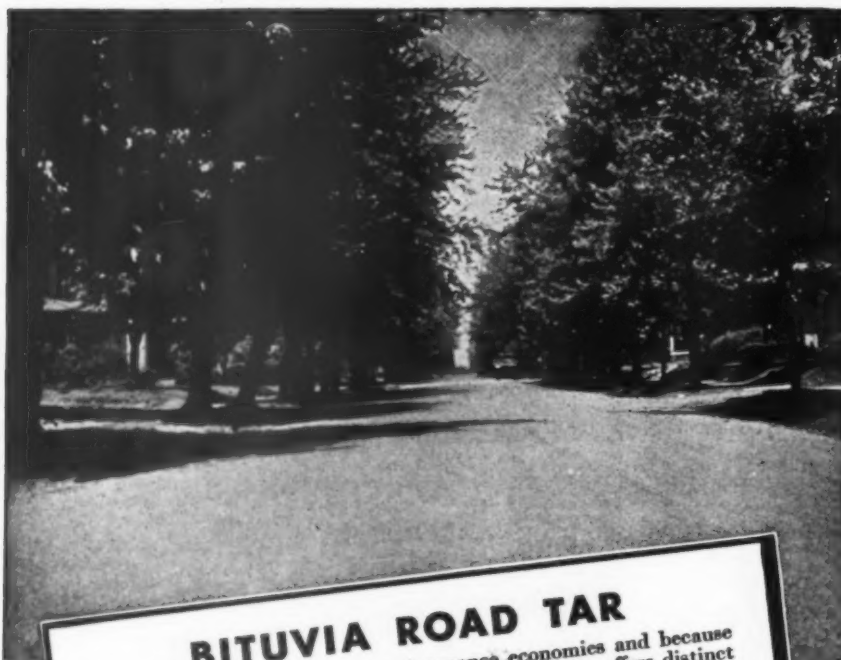
Trouble at the Crossroads.—For the second time bids received for the excavating work on the Hazelwood housing job amounting to 750,000 cu. yds. have been rejected. Donatelli & Donatelli, whose bid of \$389,192 was low on June 4th, were low again with \$453,732.25. However, the officials of the authority at a meeting on June 15th decided there was not sufficient funds available to finance the construction of the project if the various operations were let separately. This being the case, all bids were rejected and new tenders will be requested.

These new bids, which will be opened June 27th, will cover the entire job. The successful bidder will be required to take care of all work, including the general contract, excavating, plumbing, electrical work, etc. In other words, everything will be included in the general contract. Pending receipt of these bids and the disposal of the same, nothing will be done in the way of making awards on the Arlington Heights and Northside projects. Bids have already been received on these jobs, but if the Hazelwood experiment shows the authority officials that it will be more economical to readvertise, as in the case of Hazelwood, that action will be taken, all the work being grouped in the general contract.

* * * * *

Up We Go.—Creditable reports have it that a federal airport to cost about \$900,000 will be built on the Mt. Alton site in McKean County, Penna. Bradford City and McKean County agencies are now pondering over the advantages and disadvantages of the proposed site. When pondering ends and action begins the site will be purchased jointly by the City of Bradford and McKean County at a cost of \$25,000. The McKean County Commission-

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ers, according to what can be learned, have promised to pay half the cost of the site and half the annual \$10,000 maintenance for the fields. The Mt. Alton site was approved for an airport sometime ago, but has not yet been accepted by the federal government.

* * * * *

The Man for the Job.—Profanely discussing the antics of his striking shovel and tractor runners with an equipment salesman, the superintendent of a construction job was approached by an unemployed common laborer. "Say, boss," said the fellow out of work, "could you use a fellow with a good strong back for pick swinging?" Said the Superintendent. "Sorry, we've got all the laborers we need, but I'll be glad to give you a job running a shovel or a tractor 'til a laboring job shows up." Evidently the superintendent, at the moment, had little regard for shovel operators or operators of any other "mechanized units."

* * * * *

Could Be.—Driven into the ground along the side of the road leading from South Bend to Chicago is a stake with a superbly phrased sign on it. Before reaching this particular sign, a traveler notices many others along the same road which simply state—"Slow Down, WPA men at work." Then comes the masterpiece, showing what an ingenious mind can do with a couple of punctuation marks. The sign states, or rather boldly asks—"WPA men —AT WORK!?"

MONTANA AREA

Reported by
L. E. JONES

Appointment Confirmed.—The appointment of Howard W. Holmes as chief engineer was confirmed by the Montana Highway Commission on June 14. Mr. Holmes has been acting chief engineer since his selection several months ago by Governor Ford.

* * * * *

Dinosaur Bed Road.—The business men of Montana are well aware of the value of the tourist trade to the state. Concrete evidence of this fact is to be found in the work of the highway committee of the Glasgow Chamber of Commerce. Following a conference with the chairman of the State Highway Commission the committee announced it would make immediate application for the survey and construction of 12 miles of road to open up the Fort Peck dinosaur field. The construction of this short road will permit tourists to drive to the heart of the dinosaur bed, one of the largest in the world.

* * * * *

Letting for June 25.—Over 51 miles of road improvement in addition to bridges and guard rails were included in the projects let by the state highway department on June 25. Results of this letting were not known in time to be published in this issue.

Work on the Rogers Pass road was included in the projects for which bids were received. Grading and surfacing of the 7.7 miles involved were set up as one job while the bridges on the road were in another.

Promote Highway.—Montana has joined with North Dakota and Minnesota in drafting promotion plans for publicizing U.S. 2 to American motorists. This is another example of the growing consciousness of the value of tourist trade and the part played by good roads in securing the state's just share of this profitable business.

* * * * *

MICHIGAN AREA

Reported by
J. M. TELFORD

Equipment Tax Exemption.—Michigan's legislature adjourned recently without having made any radical changes in the

laws affecting contractors and the construction business in general. One important bill, exempting portable construction machinery and equipment from the trailer weight tax, was passed. Under one interpretation of the former law, heavy taxes would have been levied against any "towable" equipment, including such items as air compressors, pumps, portable gravel plants, concrete mixers, etc. The new law specifically exempts towed vehicles which are not intended primarily for the transportation of persons or property.

* * * * *

Right-of-Way Condemnation.—Another action of the legislature paves the way for condemnation of property for limited-access highways.



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Standard in the Specifications of 36 State Highway Depts. for concrete curing



For keeping rain from pulverized grade on soil cement jobs.



For protecting prepared windrows in road mix work.



For covering tools, equipment, materials — for closing in.

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San Francisco . . . 55 New Montgomery St.

Anticipation Borrowing.—In the future, county road commissions will be permitted to borrow in anticipation of weight and gasoline tax refunds. County road commissions may set up pension and retirement plans for their employees.

Registered Engineers Only.—The county road commissions must, in the future, employ only registered engineers as superintendents.

New Highway Building Proposed.—A new building to house the state highway department may be erected in Lansing, or nearby, as the result of passage of a legislative resolution suggesting the possibility of such action. The Michigan highway

department is one of the comparatively few in the country that is not housed in its own building; it occupies most of the fourth floor of the State Office building and rents space in several other Lansing buildings. The highway structure, which would be paid for out of highway funds, was suggested as an alternative to a plan to build a \$1,500,000 addition to the State Office building.

Michigan Appointments.—David F. Ruse has been appointed Finance Director of the state highway department to succeed Richard H. Barkell, who resigned to become a member of the Public Service Commission. Dale Munk, formerly Chief Auditor, has been promoted to be Ruse's

assistant; M. J. Vande Bunte has been named Chief Auditor; and Ed S. Daugherty will be the latter's assistant.

Lansing Appointments.—Glenn P. Manz has accepted the position of City Engineer for Lansing. Palmer H. Slack is the city's new Superintendent of Public Works.

Contracts Awarded.—Charles Wer-muth & Sons, Birmingham, new west side high school in Lansing.

Louis Garavaglia, Detroit, low bidder at \$203,000 for surfacing streets and alleys in Fort Custer. A previous contract for paving streets and gasoline station driveways at the Fort was awarded to the Bridgeport Core Sand Company of Saginaw at \$53,106.

Factory Additions.—Recent factory addition construction projects include one at the Tompkins-Johnson Company plant in Jackson, being built by the North Moller Company, and one at the Motor Wheel Corporation in Lansing. The contractor on this project being the Reniger Construction Company.

Super-Highway Work Proposed.—Several important construction projects are on the 1941 Wayne County Road Commission program, according to Leroy C. Smith, Engineer-Manager. Among these are the Davison Limited Highway, a widening and grade separation project on Six Mile road, and widening and divided highway projects on W. Jefferson avenue and Southfield Superhighway. Many other lesser jobs are also to be completed.

Snow Removal Aid.—The \$200,000 annual appropriation to assist counties in snow removal hereafter will come from the state highway fund instead of from the general fund.

KANSAS CITY AREA

Reported by
PAUL L. MATCHETTE

Labor Shortage.—Missouri is beginning to experience a shortage of skilled labor. Several employment services are reporting that they are receiving from five to ten requests for every man they have been able to place. The supply of less-skilled laborers is also beginning to diminish.

New Question Session.—E. C. L. Wagner, secretary of the Missouri A. G. C., Jefferson City, has instituted a very novel plan called a Question Session at the monthly State Highway Department road lettings held at Jefferson City.

The Contractors, Material Men, and Machinery men meet with the State Highway Engineers. Unsigned questions, pertaining to different jobs and highway policies, also contractors' methods, etc., are placed in a box and drawn out one by one. Lively discussions are had, leading to a better understanding on all sides. The meeting is then followed by a dinner.

Mr. Wagner is to be congratulated on this new idea. It helps everyone concerned

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PARIS, ILLINOIS

and irons out many difficulties before they happen.

Road Work at Fort Leonard Wood.—Perry McGlone, Kansas City grading and paving contractor, has rented his equipment to the W. P. A. for grading part of the highway, Missouri No. 17, from Fort Leonard Wood camp to U. S. Highway 66 in south central Missouri. Mr. McGlone will receive a unit price per cubic yard of excavation for the rental of his equipment.

The work should be started by July 15. The road will be two miles long, entirely within the military reservation. It will be a four-lane concrete highway.

Contractors Get Maintenance Work.—According to Missouri State Highway reports, the Maintenance Department in 1940 let by contract approximately \$544,000 in maintenance to contractors, consisting of bituminous surfacing, about \$125,000; shoulder oiling, approximately \$6,000; and gravel replacement, around \$413,000.

Jack Edward in New Job.—Many of Jack Edward's friends will be glad to know he is in charge of the road paving program at Fort Leonard Wood, Missouri. The plans cover 53 miles of pavement, consisting of concrete, asphaltic concrete, and bituminous mat. Without question, Jack Edwards is one of the best paving men in the business. He was formerly with the Colorado State Highway Department, and with New Mexico Construction Company. He is now working as civilian engineer, with H. M. Brock, Major, in charge of lump sum contracts. Constructing Quartermaster Corps. Fort Leonard Wood is exceedingly fortunate to have both of these men in charge of its construction work.

A. L. Cook Passes.—It is with a great deal of sorrow that we mention the loss of Mr. A. L. Cook, veteran and beloved contractor of Ottawa, Kansas, on June 7. Mr. Cook was 63 years old and had been a leader in the construction industry for over 44 years. He headed many construction outfits, consisting of Cook and O'Brien Construction Company, Kansas City; Cook and Ransom, Cook and Cone. Cook and Waddell, Cook and Tucker, Cook and Alderman, Cook and Henery, Cook and Sanders Brothers, all of Ottawa, Kansas.

Mr. Cook was perhaps one of the best known public works contractors in the state of Kansas. He was beloved by everyone who knew him. Mr. Cook and his organizations paved more roads and streets than perhaps any other men in the southwest. He will long be remembered for the many fine and wonderful things he did.

La Junta Airport Job to Start.—D. H. Hardman, Alton, Kansas, well-known road building contractor, is just finishing up his airport job west of Goodland, Kansas. He is now grading and will start surfacing the runways on his La Junta Colorado Airport job very soon.

Mr. Dean Dillon, in charge of all field operations, and Mr. Paul Thompson, in charge of records and the office, are associated with Mr. Hardman. These three men make a combination hard to beat when it comes to grading, paving, and aggregate production.

San Ore Construction Co. Making Good Progress.—San Ore Construction Company, McPherson, Kansas, is making fine headway with their airport job at Santa Fe, New Mexico. The combination of

Claire Miller, managing partner, Dale Miller, and Lloyd Miller, all brothers, and their uncle, Guy Webb, is one that has made history. At the present time they are, perhaps, the largest Kansas operators in building roads and streets and producing aggregate. They operate from Nebraska down to the Gulf of Mexico. They all are young men and keep up to the minute on methods and equipment. Last year they constructed in the neighborhood of 200 miles of road paving.

Another Airport Job Awarded.—Dahlgren & Brooks, contractors of Oklahoma City, have just recently been awarded the paving of runways on both Airport No. 1 and Airport No. 2, at Oklahoma City. Airport No. 1 consists of 19,000 tons of asphaltic concrete to be laid 1½ inches thick on an emulsified stabilized base.

tic concrete to be laid 1½ inches thick on an emulsified stabilized base.

Airport No. 2 calls for approximately 90,000 tons of hot sand asphalt. Slim Dahlgren plants to operate 18 hours per day on these two jobs and finish them up by the first of October. If it can be done, he will do it.

* * * * *

ST. LOUIS AREA

Reported by
O. B. AVERY

Building Job at Barracks Let.—A total of \$2,480,097 of construction work at Jefferson Barracks is embraced in three contracts let by the War Department at

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Washington. The contracts given, (1) to Joseph A. Bass Company, Minneapolis, 6000-man cantonment, \$1,112,600; (2) to Evans Construction Company, Springfield, Ill., 4000-man cantonment, \$677,243; (3) to O'Driscoll & Grove Company, New York, hospital group, \$690,254.

Road to Airport Sought.—Following a meeting with members of the Missouri State Highway Commission, Mayor Becker of St. Louis said an attempt would be made to have \$2,400,000 for a better traffic artery from St. Louis to Lambert-St. Louis municipal airport included in the national defense construction appropriation bill now pending in Congress. Two alternatives have been recommended, (a) widening of Natural Bridge road from the city limits to the airport, estimated to cost \$1,000,000, or (b) construction of a new highway to parallel Natural Bridge road about a half mile north of it, estimated at \$2,400,000.

Munitions Plants Double Capacity.—A TNT plant in St. Charles, double the capacity originally intended, and a small arms ammunition plant, more than double what had been contemplated, will result from the \$78,850,000 expansion announced by the War Department. The small arms ammunition plant, under construction at Goodfellow and Bircher boulevards, will employ 24,000 workers instead of 10,000 as contemplated at first, and the TNT plant at Weldon Spring, St. Charles County, will employ 2500 instead of 1500. For the small arms ammunition plant the new allotment provides \$58,850,000 to be used for land, buildings and equipment. The other \$20,000,000 will go to the TNT plant, where there is no need for additional land, but where manufacturing facilities—buildings and equipment—will be doubled. Both Maj. Carl R. Dutton, commanding ordnance officer at Weldon Spring, and Maj. David L. Van Syckle, commanding officer of the St. Louis ordnance plant, said construction under the original schedule had been proceeding as planned, and that manufacturing would begin in September. Not until then, they said, would construction of the expanded facilities be undertaken. Maj. Van Syckle said he did not know how much new land would be required at the ammunition plant, or what property would be acquired, but that it would have to be contiguous to the plant under construction.

Missouri Roads Need 10 Million.—Plans calling for approximately \$10,000,000 in federal funds for widening of existing highways and building of new roads in Missouri, made necessary by the construction of defense projects such as Fort Leonard Wood, the TNT plant at Weldon Spring, small arms plants at Lake City and St. Louis, and expansion of Jefferson Barracks are being prepared by the Missouri State Highway Department. The \$10,000,000 will cover only emergency needs. It is estimated that to put Missouri highways in first-class condition for defense requirements it would cost more than \$42,000,000.

The emergency schedule, besides the superhighway, calls for the construction of a four-lane pavement of Route 17 from U.S. 66 into Fort Leonard Wood, making U.S. 66 a dual highway divided by parkway

from Waynesville to Newburg; a dual highway of U.S. 40 and 61 from the TNT plant to the Missouri River Bridge; building a new road as a substitute for Route 94, which has been closed from the main entrance of the TNT plant four miles toward St. Charles; road approach to the small arms plant at Lake City, Mo., outside Kansas City, and extension of Lindbergh road from U.S. 61 and 67 to Jefferson Barracks connecting with new bridge at that point.

WPA Allotment for Roads in St. Louis County.—Allotment of WPA funds for a \$2,399,000 road construction and reconstruction program in St. Louis County was announced at Washington. Work to be done will include two access roads for Jefferson Barracks, one for Lambert-St. Louis Field and an undetermined mileage of improvements on old, minor roads. The WPA allotment was \$1,799,252, to which will be added about \$599,751 from regular county road tax revenue.

The Jefferson Barracks access roads, each a mile and a quarter long, will run east from Lemay Ferry road; each will have a 20 ft. bituminous macadam pavement. One will follow Reavis Barracks road and Sigsby avenue, the other Sappington Barracks road. The thoroughfare at the airport will be a new one, adjoining the north edge, to serve the enlarged Curtiss-Wright airplane factory. It will be bituminous macadam, 40 ft. wide.

Outstanding work certain to be done, in addition to the foregoing, said Jablonsky, includes: One-mile extension of Delmar Boulevard, University City, between Old Bonhomme and Price roads, 20 ft. concrete; new bridge over Wabash Railway at Hord avenue, Jennings; new bridge over Gravois Creek at Weber road for better access to River des Peres Parkway; bituminous macadam paving for Wild Horse Creek road, between Babler State Park and Manchester roads (recently started); improvement of Hencken road south from Manchester road to serve the State's Rockwoods Reservation.

Contracts Awarded and Low Bidders on Illinois Work.—McCarthy Improve-Co., Davenport, Iowa, awarded earth dike at \$21,600 by U.S. Engineers office.

Danville Construction Co., Danville, Ill., awarded 2-span bridge in Danville, Ill., \$25,566.

Powers-Thompson Construction Co., Joliet, Ill., awarded reconstruction of upper approach wall at Marseilles Lock, Ill., \$88,996.

Among the low bidders at the June 13th letting of the Illinois State Highway Department were the following:

Madison Construction Co., Edwardsville, Illinois, 0.78 miles of 20 to 22 ft. concrete approaches to Pennsylvania Railroad overhead. Relocation of Route 11 in Bond County, \$120,962.

Hoeffken Bros., Belleville, Ill., 2.22 miles of 22 ft. concrete spur to Scott Field on Route 161 in St. Clair County, \$125,936.

Earl Walker, Sullivan, Ill., 2.06 miles of 22 ft. gravel or crushed stone surface in Lawrence County, \$25,091.

Madison Construction Co., Edwardsville, Ill., 1.11 miles of 20 ft. and 22 ft. concrete approaches to Illinois Terminal and Alton

R. R. subway in Macoupin County.

Burch Construction Co., Effingham, Ill., 3.90 miles of grading in Edwards-Wayne County, \$96,286.

Lake Bros. Construction Co., Effingham, Ill., 3.39 miles of grading in Perry County, \$40,962.

Parham Construction Co., East St. Louis, Ill., concrete paving on Route 12 in Bond County, \$59,303.

Sangamo Construction Co., Springfield, Ill., concrete substructure and erection in Greene County, \$48,580.

William Lough & Sons, Marion, Ill., was low bidder at May 9th letting on bridge and paved approaches at Dallasania in Saline County, \$16,476.

* * * * *

Contracts Awarded and Low Bidders on Missouri Work.—L. W. Riney, Hannibal, Mo., 0.336 miles of grading, bridge and surfacing in Schuyler County, \$10,766.

L. W. Riney, Hannibal, Mo., 3.030 miles of grading and surfacing in Marion County, \$14,100.

Hannibal Construction Co., Hannibal, Mo., 5.184 miles of grading and 22 ft. asphalt paving, Pike County, \$117,272.

Mike Haase Construction Co., Kansas City, Missouri, 2.822 miles of grading, bridge and surfacing Route 35 in Clay Co., \$26,853.

W. J. Menefee Construction Co., Sedalia, Missouri, 2.596 miles of grading and gravel in Moniteau Co., \$15,070.

W. J. Menefee Construction Co., Sedalia, Missouri, 1.551 miles of grading and surfacing in Gasconade Co., \$9,869.

O'Dell & Riney Construction Co., Hannibal, Missouri, 1.269 miles of surfacing and grading in St. Charles County, \$53,571.

L. L. Sharp, Springfield, Missouri, 8.656 miles of grading and bridges in Jasper County, \$47,877.

L. V. Hites Co., Kansas City, Missouri, 0.723 miles of grading, bridges and bituminous surfacing in Lawrence County, \$121,309.

Keifner & Geile, Perryville, Mo., 0.023 miles of bridges on Route 14, Butler County, \$21,263.

Koss Construction Co., Des Moines, Ia., 0.26 miles of bridges on Route 14, \$16,971.

Mittry Bros. Construction Co., Los Angeles, Cal., awarded excavation for spillway for Clearwater Dam at Piedmont, Missouri, \$2,790,081.

* * * * *

MISCELLANEOUS NEWS

Award by the Indiana State Highway Commission during June of twenty contracts for road and bridge construction on the state highway system at a cost of \$1,211,309.20 has been reported.

The work placed under contract during the month included improvement of 143 miles of roads and the building of 17 bridges in 24 counties.

Six of the road improvement contracts were for work on feeder highways and two other contracts provided for surface treatment of 106 miles of roads in the Vincennes and Seymour districts.

With one exception, all contracts awarded during June provide for the completion of work during the current year.

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Haul it
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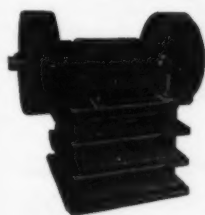


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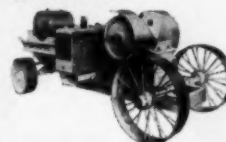
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Portable Crushing Equipment built to take it. Expertly designed to meet your exact requirements in proper size aggregates—larger capacity and quick mobility to and from the job.



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SAVING No. 1

Instead of placing wood cribbing underneath the pile driver, the contractor used Monotubes for this purpose. The steel casings were driven to a depth of 85 ft. in one piece, after which short extensions were tack welded intermittently to the tops. Then cap timbers were placed across the extension and the driving rig moved into position. The Monotubes not only had the strength to sustain the load but offered sufficient rigidity without the aid of cross bracing. Over 600 piles were driven in this manner at a considerable saving to the contractor.

SAVING No. 2

Monotubes saved valuable installation time because this same strength and rigidity permitted driving without core or mandrel—a most important factor today, when time limits are rigidly enforced.

For further information on Monotubes' many time and money-saving features, write for copy of Catalog No. 68A.

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MANUFACTURING CO.
CANTON, OHIO

NEW EQUIPMENT and MATERIALS

New Model Mobilcrane

The Osgood Company, Marion, O., has announced a new improved Mobilcrane, the Model 705 WM. Among the several new features on the 705 WM are: air control of all movements, independent boom hoist, independent travel and swing motions, and hook rollers. The Model 705 WM Mobilcrane is a sturdy, strong machine, built to move over rough ground and work under severe conditions without setting up exceptional strains in the mechanism. A feature of the extra strong truck frame is its three-point suspension, which eliminates twist and strain when traveling over rough surfaces. When lifting, the front axle is provided with leveling jacks



Osgood Model 705 WM Mobilcrane

to keep the upper body on an even keel. The upper body is kept on the revolving base through the use of hook rollers. The gear driven transmission provides four speeds, ranging from $\frac{3}{4}$ to 5 miles per hour. A heavy roller chain transmits the power from the differential to the tandem rear wheels all driven, which are mounted as a unit, and oscillate when traveling over rough, uneven ground. The final driving chains are enclosed in an oil tight chain case. The heavy front axle is supported in a pintle, allowing up and down movement of the axle. Steering is accomplished by slewing the front axle with an hydraulic cylinder, operated by the operator from the cab.

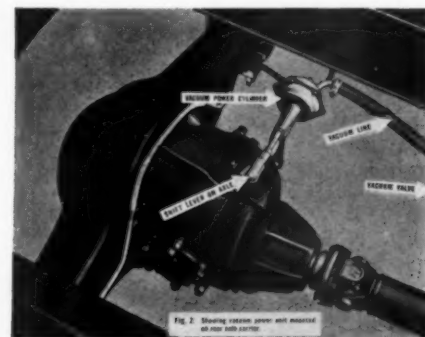
New Light Weight Air Hose

A specially designed light-weight air hose for pneumatic riveters, chippers, and other tools has been announced by United States Rubber Co., Rockefeller Center, New York. The new product weighs only 20 lb. per 100 ft. The designers claim that strength has not been sacrificed by lightening the new hose. It is made with a 1/16 in. thick oil-resisting rubber tube, one-ply

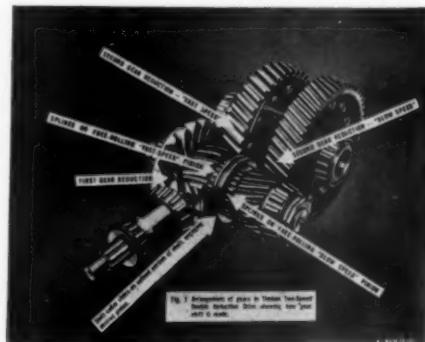
of specially braided light-weight yarn, and a 1/16 in. abrasion-resisting cover. Its burst value is stated to be approximately nine times the average operating pressures encountered in this service.

"Easy-Shift" Developed for Timken Two-Speed Axles

Engineers of the Timken-Detroit Axle Co. have developed "Easy-Shift" for Timken two-speed axles. The shift is stated to be the result of a revolutionary design of spline teeth (patents applied for) which allows an instantaneous engagement of the shift collar with the desired spur pinion at synchronized speeds. The change of gear ratios on Timken two-speed double reduction axles is accomplished by shifting a



collar on the cross shaft from engagement with one spur pinion of the second gear reduction into engagement with the other spur pinion (see Fig. 1). With the new design of spline teeth, gear shifts can be made without declutching in most instances with a little practice. Not only is the shifting made unbelievably easy for manual control but it is now possible for the first time to utilize remote control power shifting—vacuum, compressed air, or mechanical. The Timken "Easy-Shift" has been hooked up with power shifting in several ways by vehicle builders. Where vacuum power is used, a vacuum cylinder shifts in one direction by the use of vacuum and in the return direction by means of a spring. This power

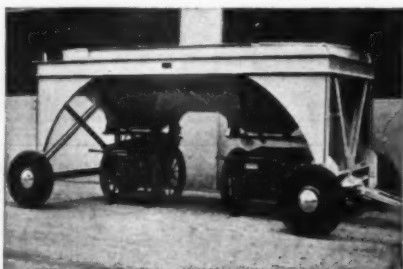


unit is mounted directly on the differential carrier. A control button, or cable knob, is provided in a convenient location, either on the steering column or instrument panel,

and operates the vacuum valve. The "Easy-Shift" operates as follows when the truck is rolling in fast axle gear ratio. At any time the driver may push his control to the slow position. After this, at the instant the accelerator pedal is released, the gear shift to "slow" is automatically made. Likewise, when rolling in slow gear ratio, setting the control to fast speed permits the release of the accelerator pedal at any time after that to automatically shift into fast gear ratio. Fig. 2 shows how one truck manufacturer has worked out a vacuum power actuation of the Timken "Easy-Shift." The power actuation of Timken "Easy-Shift" provides a silent and effortless shift with lightning speed from one gear ratio to the other. This results in the elimination of speed loss in shifting on upgrades, elimination of shock loads from sudden clutch engagement and also eliminates the extra control lever in the cab.

New Low Head Room Hopper for High-Dump Truck Mixers

A recent addition to the soundly-engineered Gar-Bro line of concrete handling equipment of Garlinghouse Bros., 2416 East 16th St., Los Angeles, Calif., consists of a double gate, low head room hopper for high-dump truck mixers. Specially low built, this hopper was designed to accommodate the mix from a four cubic yard high-dump



New Hopper

truck mixer. A side section is easily removed to accommodate the dumping of a three cubic yard mixer! The all-welded steel bin is built bathtub-shape to insure self-cleaning. Double clamshell gates have a floor clearance of 36 in. for loading concrete carts. Gates are 10 in. by 15 in. unless otherwise specified. Center discharge eliminates segregation. Overall dimensions, 8 ft. wide by 13 ft. long by 6 ft. 3 in. high. Total weight, 3000 lb.

New Improved Crane

A new improved General Supercrane just announced by The General Excavator Co., Marion, O., has a safe lifting capacity of 15 tons, and while it is primarily built for crane service, it can be equipped as a clamshell, dragline, pile driver, or pull shovel. It has a stronger frame, hydraulic steering and brakes, enclosed transmission and differential, and increased mobility. The upper body is of typical General design. Power is taken from the motor to the operating machinery by a Twin-Disc power take-off clutch. The swing and travel motions are controlled by two Twin-Disc friction clutches. A special brake is mounted on the lower end of the vertical

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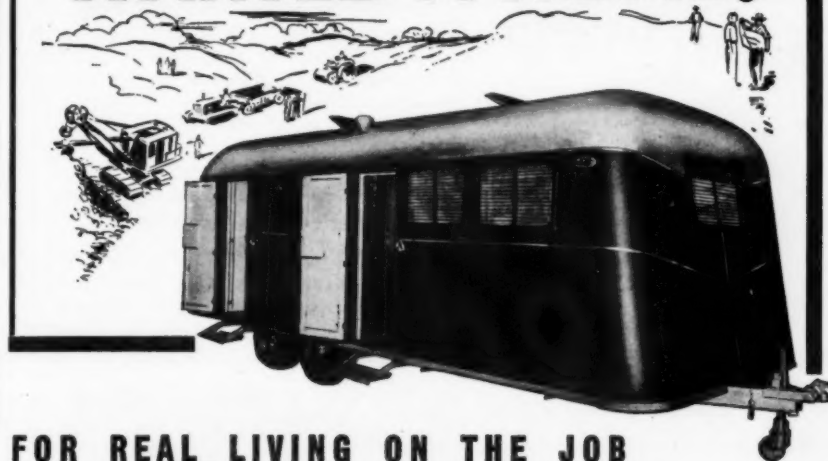


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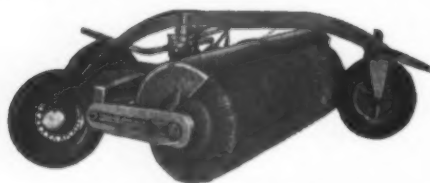
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intermediate shaft underneath the deck, which acts as a swing brake when swinging, and as an auxiliary or parking brake when propelling. An exclusive General Excavator feature, and standard on the Supercrane, is a precision hoist brake, mounted on the intermediate shaft, and connected to the hoist drum by chain drive. This special brake is stated to not only



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give three times the braking power of the normal drum brake, but also permits the backing of the load down through the gears when the engine clutch is disconnected, or permits driving the drum backward under power. The Supercrane has an independent boom hoist, of the cut steel worm and gear type, with a band type safety brake. It is entirely independent of the swing and travel motions.

WITH THE MANUFACTURERS

"Dad" Conger Is Dead

W. N. Conger, who for 24 years represented Truscon Steel Co. as highway reinforcing products salesman, died last month. Known to thousands of highway contractors and others as "Dad" Conger, he found the end of life's journey after having traveled for 85 years.

W. M. White, Jr., Becomes Vice-President White Mfg. Co.

W. McKean White, Jr., has been elected vice-president of the White Manufacturing Co., Elkhart, Ind. He is a graduate of Purdue University in mechanical engineer-



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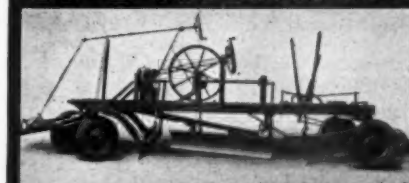
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County and State Highway Departments

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For Better Roads, put a WORKMAN
Machine on the job. 3 sizes:
**THE GENERAL • THE SUPER
THE MASTER**

YORK MODERN CORPORATION
UNADILLA, NEW YORK



SURFACE MARKERS For STREETS and HIGHWAYS

"The Eyes of the Road"

Suggestions for your problems, no obligation.

THE STAR-LITE CO., 312 E. MARKET ST., INDIANAPOLIS, IND.

ing and will be engineering assistant to his father, M. McK. White, president. The White Manufacturing Co. produces portable asphalt plants, asphalt and tar kettles, concrete vibrators, front end loaders for industrial tractors, aggregate dryers, and railway car parts.

Allison Miller Named Assistant Sales Manager of Dodge Truck Division

Appointment of Allison Miller as assistant sales manager, Truck Division, Dodge Brothers Corporation, was announced by L. D. Cosart, Sales Manager. Previous to his present appointment, Mr. Miller was Philadelphia regional manager for Dodge. A graduate of the U. S. Military Academy at West Point, Mr. Miller joined Dodge Brothers Corporation originally in 1925 as district manager in the Dallas Region. For several years he remained in field contact work in the merchandising of new and used cars and trucks. For six years following 1930 he was connected with the Dodge factory sales organization in Detroit in various advertising and sales capacities including that of assistant director of truck sales. Subsequently he became assistant regional manager at Chicago and St. Louis. In February, 1938, he was appointed regional manager in St. Louis and took over management of the Philadelphia region in 1940. During most of the 16 years that he has been connected with Dodge, Mr. Miller has been in truck sales work.

Marmon-Herrington "Office on Wheels"

Marmon-Herrington all-wheel-drive trucks and track-laying vehicles built at Indianapolis, Ind., are tested over types of terrain approximating as closely as possible that over which they will have to operate. In a great many instances the scene of such tests is many miles from the company's offices and plant. For the convenience of visiting dealers and customers, and for facilitating the work of military officials and commissions in observing these tests, Marmon-Herrington has recently placed in service a deluxe trailer which is equipped with every modern convenience. Designed and built to Marmon-Herrington's specifications by Schelm Bros., Inc. of Peoria, Ill., the trailer is in fact a mobile kitchen, diner and club lounge in which passengers can spend an entire day away from con-

ventional facilities. Accommodations are provided for twelve passengers, and a steward-chef is in charge. The trailer is pulled by a Marmon-Herrington All-Wheel-Drive converted Ford with a shortened wheel base, and a steel box at the rear of the cab is equipped to carry all necessary provisions and supplies.

Cunningham-Goggin Company Appointed Link-Belt Speeder Shovel Distributor

Link-Belt Speeder Corporation has announced the appointment of Cunningham-Goggin Co., 610 West Michigan St., Milwaukee, Wis., as authorized distributor for the complete line of Link-Belt Speeder shovels-draglines-crane, ranging from fast, mobile $\frac{3}{8}$ -yd. units to heavy-duty 3-yd. machines. The territory covered by Cunningham-Goggin includes the eastern part of Wisconsin as well as the upper peninsula of Michigan. A. H. Puffer & Co., Inc., 206 South Main St., Rockford, Ill., is authorized distributor for the western part of Wisconsin; and Rihm Motor Company, 1641 University Ave., St. Paul, Minn., handles complete sales and service in the upper western counties of Wisconsin.

White Names Tobin Retail Truck Division Sales Manager

J. N. Bauman, vice-president and general sales manager of The White Motor Company, has announced the appointment of Paul Edward (Jerry) Tobin as sales manager of the company's Retail Truck Division. This division represents one of the most important of White's manifold departments, covering as it does the sale of the heavy duty Super Power line through branch outlets and to national accounts. Tobin's 13 years previous connection with the automotive industry gives him a wealth of background for his new position with White. Born at Middletown, O., Sept. 7, 1903, he attended high school in that city and enrolled in Indiana University where he attained his AB degree in 1927. During his college years he was a three-letter man, member of Sigma Chi fraternity, president of the junior class, and cadet colonel in the R.O.T.C. Following his success as quarterback for Indiana U., Tobin played pro football for four years, while also gaining his first business experience. He joined the B. F. Goodrich Co. in 1927 and had charge of the company's sales training school in

OSGOOD



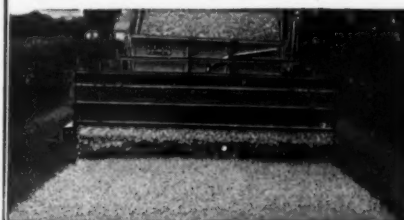
TYPE 80 AIR CONTROL

The leader of them ALL for smooth, fast and efficient shovel, dragline or crane operation.

We have a brand new catalog awaiting your request



A BURCH ON THE JOB



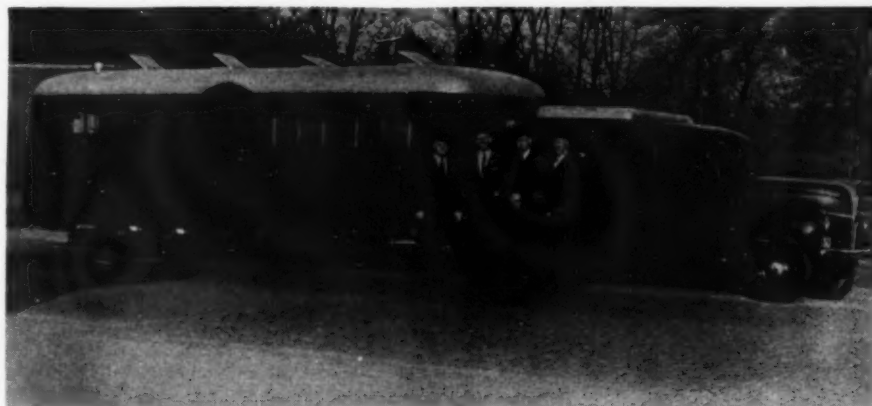
A BURCH FORCE FEED SPREADER

on the job will insure an even, uniform stone mat. Specially designed cylinder will eliminate corrugating, dual feed gate control gives a wide range of adjustment to the flow of material. The machine is operated by the movement of the truck forward or backward.

Manufactured by

**The
BURCH CORPORATION**
Crestline, Ohio

Builders of equipment for Fifty Years



Marmon-Herrington Mobile Office

CLEARING HOUSE

CLEARING HOUSE SECTION

(Not available for general advertising)

RATES

Undisplayed Classified Rate: 10 cents per word per insertion; minimum charge \$2.00, payable in advance.

Position Wanted: 5 cents per word per insertion, payable in advance.

Count 11 additional words for box number. Estimate 35 characters to the line.

Display Classified Advertising Rate: \$8.50 per column unit "inch" per insertion, payable with order, the unit "inch" measuring $\frac{1}{4}$ inch on column depth.

Contract rates in display classified advertising in this section sent on request.

Copy subject to publisher's acceptance.

New and Used Equipment For Sale

IMMEDIATE DELIVERY

All used items have been reconditioned and are guaranteed

- 1—9" x 16" bronze bearing DIAMOND Jaw crusher complete with flywheels wheels (Power: 18-26 H.P. 4 cyl. @ and Model P287D2 LeRol motor mounted on trailer unit with steel 900-1500 R.P.M.)NEW
- 2—Pitman assemblies with S.K.F. bearings including main bearings for 10" x 20" Jaw CrusherNEW
- 1—Bucket elevator 32 ft. 0-in. centers. rigid type, with buckets 12" x 8" x 7 1/2" mounted on beltNEW
- *2—Pitman assemblies for 10 x 20 Jaw Crusher, bearings S.K.F. typeSLIGHTLY USED
- *3—10 x 36 pitman assemblies for 10 x 36 Jaw CrusherREBUILT
- *1—15 x 36 pitman assembly completeREBUILT
- 1—20 ft. 0-in. bucket elevator with buckets 10" x 6" x 7 1/2" mounted on chainREBUILT
- 1—30" x 10-ft. 0-in. double shaker screenUSED
- 1—Grizzly and hopper 6-ft. 8-in. x 6-ft. 8-in. with 5-in. sq. openings and 20-in. x 3-ft. 0-in. plate feederGOOD
- 1—Quarry plant with 10 x 20 anti-draw bearing jaw crushers and fold-down type bucket elevators, size 12 x 6 x 7 1/2 in. x 25-ft. mounted on trucks with four steel wheelsNEW
- 2—30 cubic yard bins, 3-compartment, with jack legsNEW
- 6—Steel wheels 40-in. dia. x 16-in. face to take 4 in. Hyatt bearingsNEW
- 4—Steel wheels 40-in. dia. x 10-in. face to take 4 in. Hyatt bearingsNEW
- 4—Steel wheels 28-in. dia. x 4-in. face, bore 1 1/4 in.NEW
- 6—Steel wheels 28-in. dia. x 5-in. face, bore 1-15/16 in.NEW
- 8—Steel wheels 24-in. dia. x 3 1/2 in. face, bore 1 1/4 in.NEW
- 4—Steel wheels 28-in. dia. x 14-in. face, bore 4-in. HyattNEW

POWER UNITS

- 1—U-40 Allis-Chalmers power unit @ 36 Cont. HP @ 1200 RPMREBUILT
- 1—W-25 Allis-Chalmers power unit @ 25 HP @ 1300 RPMREBUILT

*The above pitman assemblies can be installed in new bases and furnished as complete machines.

DIAMOND IRON WORKS, INC. AND MAHR MANUFACTURING CO., DIV. MINNEAPOLIS MINNESOTA

Hall-Perry Machinery Co.

812 E. Iron St.
BUTTE, MONTANA

EQUIPMENT AND SUPPLIES
FOR:

Contractors

Mines

Mills

Municipalities

We will be glad to figure on equipment and supplies for any job.

Akron until 1931. He was then shifted to the company's Cincinnati office where he served as wholesale salesman, truck and bus tire manager, and sales supervisor. In 1938 he was called back to Akron where he had charge of original equipment sales for that area. In October of the same year he was named original equipment representative for the highly important Detroit area, dealing directly with the automobile producers. He held that post for three years until he joined The White Motor Company.

Christener Appointed for Ryerson

E. W. Christener has been appointed sales manager of the Chicago Reinforcing Bar Division of Joseph T. Ryerson & Son, Inc. Mr. Christener, born in Zurich, Switzerland, received his schooling in Europe, including college training in civil engineering. He came to this country in 1914 and was employed in the drafting and engineering departments of an Eastern contractor. Soon he entered the steel business but left in July, 1917, as a member of the Co. "E" of the 108th Engineers, 33rd Division, for 14 months overseas service. After the war, Mr. Christener returned to the steel business and in May, 1922, became associated with the Ryerson Co. He has had many years of experience in drafting, estimating, engineering, detailing and designing of concrete reinforcing structures. Mr. Christener has been in the Sales Engineering Department of the Ryerson Co. since 1927.

Harry Buckenheu Appointed District Manager for Smith Engineering Works

The Smith Engineering Works, Milwaukee, Wis., manufacturers of "Tel-smith" crushers and equipment for quarries, mines and gravel plants, has announced the appointment of Harry Buckenheu as New York district manager. Mr. Buckenheu will be located at Room 1604, 50 E. 42nd St., New York City, and his territory will include northern New Jersey, all of New York State and southern Connecticut. His new telephone number is Vanderbilt 6-6276. For a good many years, Mr. Buckenheu has been associated with the sand and gravel and crushed stone industry.

Mack Announces Two New Vice-Presidents

At a recent meeting of the Board of Directors of the Mack-International Motor Truck Corporation, two new vice-presidents were elected, according to an announcement by Mr. F. F. Staniford, president. The newly named vice-presidents are, W. R. Walker and H. E. Seanor, both long associated with Mack. Mr. Walker is a special representative with liaison duties between the Mack home office and the various governmental departments on all

New Gar Wood Distributor

The Standard Truck Equipment Co., 861 South State St., Jackson, Miss., has been appointed authorized distributor for the Hoist and Body Division of Gar Wood Industries, Inc., Detroit.

CLEARING HOUSE

FOR SALE

ROLLERS

- 2—Fordson 3 wheel—4 ton—Gas
- 2—10 Ton 3 wheel—Gas
- 1—5 ton 3 wheel—Gas
- 2 Gallon Portable Rollers—5 ton
- 5 Tandem Steam Roller—5-6-7 Ton

GRADERS

- 2—No. 5 Huber—12' Motor Graders—Gas—1940 Model
- 2—Austin 10' Motor Graders—Solid Rubber Tires
- 1—Gallon 10' Motor Grader—Pneumatic Tired

PUMPS

- 9—Carter Humdinger 3" Single Diaphragm Pumps
- 6—Centrifugal Pumps—2"-3"-4"

AIR COMPRESSORS

- 10—LeRol & Schramm 105' Two Stage
- 4—LeRol 210' Two Stage
- 6—LeRol 315' Two Stage
- 1—Schramm 210' Two Stage
- 1—Schramm 315' Two Stage
- 1—Schramm 105' Fordair

MISCELLANEOUS

- 9—Cleveland Sheeting Drivers
- 21—Cleveland C7 & C9 Breakers
- 15—Cleveland H 10 & H 11 Rock Drills
- 1—Cleveland WDA10 Wagon Drills
- 1—Cleveland DRS Wagon Drill
- 2—Cietrac Diesel Bulldozers—Model BD
- 1—Austin 8 yard Scraper
- 3—Lincoln 300 Amp Portable Welders, Gas Engine Driven
- 2—Hobart 300 Amp Portable Welders, Gas Engine Driven
- 1—1/2 yd. Kiesler Clam Shell Bucket with teeth.

CHICAGO CONSTRUCTION EQUIPMENT CO.
8039-41 South Halsted Street
Chicago, Illinois RAD. 5800

FOR SALE

SHOVEL, 1/2 yd. Insley, in operating condition.

WAGON DRILLS (9), Cleveland DR-8 (latest model) Universal Drill Rigs, with recoil device, for depth of 25 to 30 ft. change, mounted on three rubber tires; with D-14 DR Cleveland drifter; recommended for use with 260 ft. or 315 ft. compressor. In excellent condition.

DRILL SHARPENER, Sullivan Class C.

SCALE, Winslow 12 ton truck scale.

CLAMSHELL BUCKETS, 1/2 to 3/4 yard.

PAVER, 13E (1/2 yd.) Koehring on full crawlers, 20 ft. boom and bucket, good condition.

ROLLER, 10 ton Buffalo-Springfield 3 wheel, two cylinder gas, with scarifier, good condition.

SCRAPER, 5 yd. Austin-Western cable scraper, with winch and power take-off.

CRUSHING PLANT, Cedar Rapids 9 x 36, portable crushing plant on pneumatic tires with 40' x 14' delivery conveyor, revolving screens.

CRUSHER, Cedar Rapids 9 x 36 plain bearing, in good condition.

PILE HAMMERS, No. 3 Vulcan and No. 7 McKiernan-Terry.

CRANE BOOM, 40 ft. lattice type, in good condition. For Model 2 and a northwest machines.

Write for our complete list
O. B. AVERY COMPANY
1325 Macklind Avenue St. Louis, Missouri

FOR SALE OR RENT

HEAVY GRADING EQUIPMENT

- 1—Model KO 54 AC speed patrol grader.
- 1—Model 10-K Ryan pull grader.
- 1—No. 14 AC power controlled pull grader.
- 1—10-ton Huber roller, gas engine power.
- 1—10-ton Buffalo steam roller.
- 1—4 to 5 yard Ateco hydraulic scraper.
- 1—Model L tractor.
- 1—Model LO Allis-Chalmers tractor.
- 1—Model K Allis-Chalmers tractor with dozer.

USED TRACTOR PARTS

Large assortment parts for Models L and LO Allis-Chalmers and 60 and 65 Caterpillar, including transmissions, gears, sprockets and motors.

Write for our complete used equipment list

GENERAL MACHINERY COMPANY
SPOKANE, WASHINGTON

FOR SALE OR RENT

Rebuilt Lorain 1 1/4 Yard 75A Gas
Shovel

PETRIE MACHINERY CO.

Billings, Montana

